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Geographical Review of India

VOL. XXIII SEPTEMBER 1961 NO. 3

CONTENTS

Geographical Review of India

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FLOODS IN WEST BENGAL—A GEOGRAPHICAL ANALYSIS

S. P. Chatterjee and K. Bagchi.

The floods in West Bengal are a function of three variables : precipitation, terrain and run-off.

PRECIPITATION

Regarding precipitation, the following have been revealed from past records :—

(1) A series of rain-storms, originating in the Bay of Bengal travel inward, dying out at varying distances. They sometimes cover only portions of catchment areas but may as well enclose entire catchment of one or more rivers.

(2) If the intensity and duration are short and the catchment area is restricted, the flood has local importance only. It may readily be passed off to the sea if the incidence is in the coastal region.

(3) But if the storm is centred over the interior portion of the plateau or the central Delta, the resultant precipitation causes inflation of the lower reaches earliest and the upper portions of the river valleys receive rain later. The run-off from the head portion is added on to that which has been caused in the lower reaches. This delays flood disposal.

(4) There have been cases when rain-storms have appeared in quick succession and the ground which was already soaked could not absorb much of the rain caused in later storms. The run-off becomes accentuated.

(5) The coverage by rain-storms varies widely and individual storms have been known to cover areas from 200 sq. miles to 10,000 sq. miles. If the storm covers up an entire valley, it will cause considerable rise in flow compared to a situation when the same storm covers partially 2 or 3 catchment areas.

(6) Most of the water-logging in Calcutta and the drainage basins are caused by downpours which are concentrated in short periods.

(7) It has been found that most of the floods in West Bengal are due to :—

(i) Strengthening of the monsoon current over the Sub-Himalayan Bengal and also over the eastern section of the Nepal Himalayas due to westward movement of depression from the head of the Bay of Bengal.

(ii) Shifting of the axis of the seasonal monsoon trough to the Himalayan foot-hills thereby setting a break in the monsoon.

Major floods are attributed to :—

(i) Tista—1950 ; Mahanadi—1951 ; and

(ii) Mahanadi, Tista, Damodar—1955.

A very destructive flood occurred over the central districts of West Bengal State during the period 26/27th September, 1956. The wet spell responsible for this flood started from the evening of 25th and ceased completely by the morning of 27th. The monsoon trough and associated cyclonic circulation extending upto 500 mb level remained over West Bengal and neighbourhood during the period 23rd to 26th and shifted southward later on. Hence the abnormal rains were due to the conditions in the upper air. They can be forecasted with suitable technical know-how.

TERRAIN

NORTH BENGAL : The characteristics of the terrain are also of supreme importance in flood analysis. The factors influencing the terrain are the bed rock and soil, the slope structure and the stage in the cycle of development. The terrain in North Bengal is dominated by the Himalayan mountains. The mountains are composed mostly of sedimentaries and meta-morphics, all of which are very much susceptible to solifluction and slip. They are also susceptible to sheet erosion. The slope of

the hills encourages quick run-off and the youthful stage of the mountains and their location in a seismic belt contribute to uncertainties in respect of future assessments. The rivers on descending the slopes suffer a marked break in gradient and the load is piled up. An extensive alluvial fan has been built up in which the braided streams lose themselves. Any measure in flood prevention is to consider how best to reduce the load upstream and stabilise the course lower down. If guiding embankments are constructed without arresting the load in higher levels, the result will be to lead to raising of the thalwegs and ultimately taking the rivers above the levels of the surrounding country. This will invite more catastrophic floods in future.

West Bengal Plateau : The terrain in the plateau region may be considered as a mature area where the slopes have considerably flattened out. The rocks are, however, crystalline gneisses and older and newer alluvia . They are friable in most cases and soil erosion and gullying are common features whenever the land is not properly taken care of.

The region north of the Ajoy and to the west of the Bhagirathi is characterised by a high land adjoining the Chotanagpur plateau, a levee of older alluvium bordering the Bhagirathi and an intervening depression. The tendency of water-logging in this depressed region is a chronic phenomenon. Any step towards flood control should aim at restoring the flow conditions of the rivers draining this depression if it is found possible or alternatively in pumping out the water artificially when the situation warrants it.

Damodar Region : The Damodar region is another area which needs special attention. The factors which need scrutiny are those relating to—

(i) the friable nature of the ground contributing profusely to soil erosion and consequent increase in the load of the streams ;

(ii) the high levees which have enclosed the natural channels and now restrict flood spill thereby intensifying the depth inside the channels and subsequent drainage of the interfluve after the spill has taken place ;

(iii) the tendency for sagging of the region between the plateau and the levee along the Bhagirathi-Hooghly which has created an undefined drainage region covered by the Behula, the Kunti, the Ghea etc. and the marshes in the P.S. Polba, Chanditola, Jagatballavpur etc. ;

(iv) and lastly the high stage of the Damodar, the Bhagirathi-Hooghly and the Rupnarayan during the floods when the banks which being friable give away and the escaping sand spreads over vast areas rendering cultivable land sterile. Vast areas have gone out of cultivation through either the spreading of sands or the water-logging as a result of sagging.

Central Delta : The problem of the central delta is yet more complicated. Seismic indications confirm the geomorphic lie of the region as a sedimentation basin. The rivers though enclosed within levees yet find it difficult to maintain a steady progressive gradient from the head to the outfall. The result is that the marshes are increasing in area except to the extent they are being filled up by accumulation of surrounding drainage. The marshes in Nadia and 24 Parganas are instances in point. Whenever there is excess precipitation, the marshes encroach beyond their normal limits. This region is also full of numerous cut-offs and sometimes their links are restored, e.g. the *Paglachandir Dah* in the border of Murshidabad and Nadia occasionally becomes joined up during the rains with the main stream Bhagirathi. This also causes floods in regions least expected. Sometimes old courses have been converted to cultivated fields, e.g. the Adiganga Channels in 24 Parganas and their low regions come to be revived even though temporarily.

The Sundarban Region : The Sundarbans represent an area where the premature reclamation has heightened the flood effects. Inundations should have been the normal state of affairs during high stages in the rivers (such high stage being caused by storms, tides and upland flow coinciding). The settlements and types of land use should have been conditioned accordingly. Unfortunately, land-hunger and the necessity to clear up the hinterlands of the port of Calcutta led to throwing up of embankments leading to interference in the land building activity of rivers and even their

physical survival. The Adiganga, the Bidyadhari and the Matla on which Canning is situated are instances in point. The tide levels of the Hooghly are constantly on the increase.

RUN-OFF

The run-off is another important item determining flood intensity. The run-off is affected by :

(i) the texture of the ground on which the water moves ;
(ii) the slope ; and
(iii) the period for which precipitation takes place.

Specific studies have not yet been taken up for determining the rate of run-off in varying conditions of slope, rainfall etc. in areas beyond the DVC region. It seems, however, that deforestation and intensive agricultural practices have combined to increase the rate of run-off throughout West Bengal in general. Afforestation and contour ploughing are likely to reduce the rate of run-off and contribute to flood prevention.

COMPARATIVE STUDY OF EAST ASIAN AND INDIAN VILLAGES

Jiro Yonekura

Introduction

India's villages were first studied scientifically by Sir Henry Summer Maine.[1] He wrote a book titled *Village Communities in the East and West* in 1871. In this book, he compared India's villages with old German villages which the German scholar, Von Maurer, studied admirably at that time. His conclusion was that the old India's villages would have almost the same kind of community as old German tribes ; but he found that India's agriculture needed much water because of the tropical climate.

Maine could use very limited materials, so his conclusion was later criticized by Baden-Powell.[2] The latter's research was on Indian village communities from the view point of land-holding and geographical and physical features of India as affecting the movement of agricultural castes and their forms of holding. He denied the common ownership of land-holding of original Hindu villages in India and his opinion can apparently be applied to East Asian villages as well. His explanation is very rich in economic history but is poor in regard to settlement geography.

From the standpoint of geography, F. V. Richthofen[3] at first made a comparative study of villages of India, East Asia and West Europe. He classified the villages of the world according to the stage of agricultural technique. He expressed the opinion that agriculture achieved higher technique in two processes, one by using more and more man-power and the other by using cattle power and later mechanical power. The former appeared in the East and the latter in the West. The former is characterised by irrigation and the latter by the combination of crop cultivation with stock-breeding.

General character of India's villages

F. V. Richthofen classified India's villages into the East Asian type ; but India's farmers cultivate crops as intensively as East Asian villagers while they practise cattle breeding at the same time. So, roughly speaking, India's villages stand between the East and the West.

Although in Indian villages cattle breeding is practised, the way of breeding is quite different from that of European villages. In Europe, villages have pastures and even cultivated fields left

fallow alternately, while the fallow land is used as temporary meadow. The so-called three-field system which flourished in medieval Europe is the system of rotation of the crop cultivation in fallow land with a three-year cycle.

In Indian villages there is no pasture as in European villages, only waste land is used for cattle grazing, and of course cattle are put on the field after harvesting. I think in ancient times India's villages had vast uncultivated woodlands or jungles where they could graze their cattle ; but as crop cultivation intensified in the way of East Asiatic farming, the woodland around the village was cleared up until there remained only barren waste land.

In East Asia, most of the villages have a very small number of cattle only for ploughing. In an extreme case, for example, in Sanuki province in the Shikoku district of Japan, farmers have been used to borrow oxen from the neighbouring mountainous province of Awa. After ploughing, oxen are sent back with rice-bags on their backs as rewards. So these oxen are called rice-oxen.

It is said that man can live on one-fifth area of field when he takes vegetable food. If he prefers only animal food, five times an area will be needed for the fodder of those animals. So, in East Asia, the pressure of population expelled the cattle from villages.

In this case, we consider the fertility of land. The loess of Howangho valley and its lower plains, Yangtze delta as well as the alluvial plains of Japan are very fertile. Man can produce as many crops as man power can permit.

In Europe the soil is comparatively poor and, especially, the climate is cool. So the natural fertility of soil is far below that of East Asia. Man must cultivate large fields to produce enough crops in Europe. Accordingly, European agriculture technically needs cattle power. The cool climate is also suited for cattle keeping. There is plenty of good wild grass for grazing cattle in the field and on the mountains. So it is quite natural that agriculture of Europe is more dependent on cattle rearing than on crop cultivation.

In India, natural conditions are almost the same as in East Asia. Here also intensive crop cultivation developed as well, but Indian villagers keep cattle as the farmers of European villages. I think this is due to the special conservatism of the Aryan peoples, who depended on pastoral life for a long time, and

for whom cattle keeping became not only an occupation but a religious practice.

They started taking vegetarian food only, but they take cow's milk and buffalo's milk as one of their chief foods. This may be the cause why they cannot do without cattle breeding.

Although India's crop cultivation is almost the same as in East Asia, there is some difference. F. V. Richthofen classified Asian villages by the form of irrigation. One is Schwemmrieselung (inundation) and the other is Einzelrieselung (canal irrigation). In his opinion, the former is practised in India and the latter in East Asia, namely in China and Japan.

We know in India canal irrigation is developing every year and even in ancient times, especially in the Punjab, irrigation canals were dug. But generally speaking, India's villages depended more upon natural inundation than on canal irrigation.

If we compare the Ganga delta with the Yangtze delta, the contrast is very clear. In the Yangtze delta there develops a net-work of creeks at an average interval of about 380 ft[4]. These creeks are mostly artificial irrigation and drainage canals and at the same time many of them are used for navigation by small steamers and junks.

In the Ganga delta, we can see many river beds, old and new, and swamps but we find few artificial canals.

In Japan, though the scale is small, irrigation system is developed intensively, and regulation of irrigation is precisely ruled by village community or by inter-village councils.

Village pattern, square or rectangular

Village patterns are decided by many natural conditions. About village patterns of India, Prof. R. L. Singh[5] of Banaras Hindu University has carried out some researches, though his illustrations are limited to the middle Ganga valley.

India's villages are in general agglomerated in type as in East Asia and we can find well planned square or rectangular village pattern in Japan and South India. Of course India has many types of village patterns. I shall discuss in this paper only the origin and the spread of this rectangular pattern in India comparing with that in East Asia.

In ancient history when some society became so large to cover pretty vast territories under a common government, the idea of planning or the reclamation of the land and of the establishing

village and city occurred in the East and West as well as in India. Some scholars[6] think the idea was first laid out in India ; from there it spread to Orient or to China. But this hypothesis cannot be proved in the present stage of our knowledge.

The writer[7] already published his opinion on the development of the grid-pattern land allotment system in East Asia ; its contents will be reviewed briefly for comparison.

In ancient China, one of noted philosophers, Mencious, who was born in the 4th century B. C. in the intensive agricultural region of lower Howang-ho plain, advocated the so-called Tsing-t'ien system. It means literally 'well field' ; he idealized the plan from small hamlet which gathered around a well.

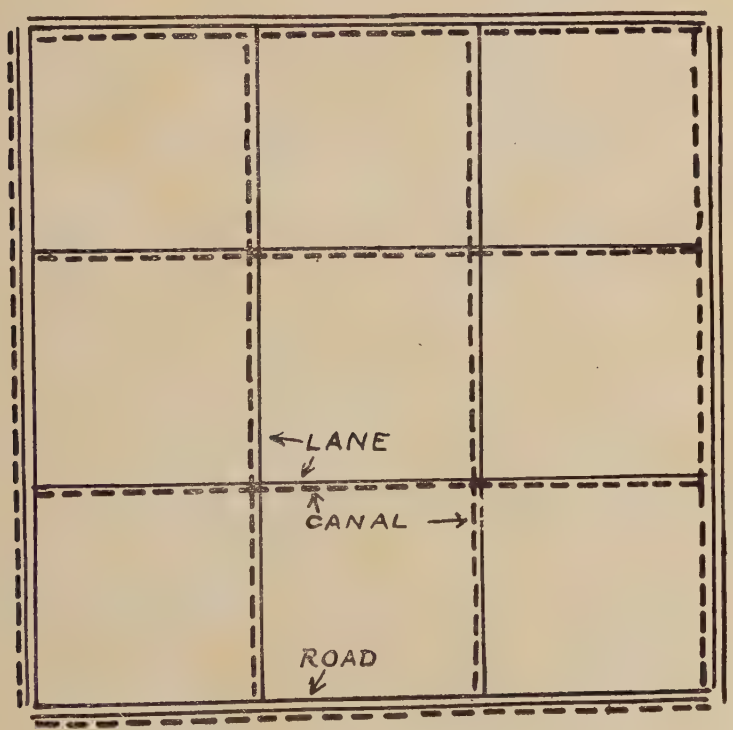

FIG. 1. TSING-T'IEN SYSTEM.

This system was a square pattern land allotment with 400-metre squares as its basic units. This is called Tsing-t'ien and divided in nine sections, each called Fu, which means one family share. Eight families settled in the central Fu section and cultivated another eight Fus around. (Fig. 1)

There is another classic which was called Chu-li, the encyclo-

pedia of Chu dynasty. There are chapters devoted to the technology of rural and town planning and also making of roads, lanes and irrigation canals. This book is said to have been compiled about the beginning of Christian era, and it contains many old traditions. Planning was all systematized on the basis of Tsing-t'ien system.

We can see the Yangtze delta irrigation canals running parallel and crossing at right angles, forming rectangular land sections. This must be the remnant of the planned allotment.

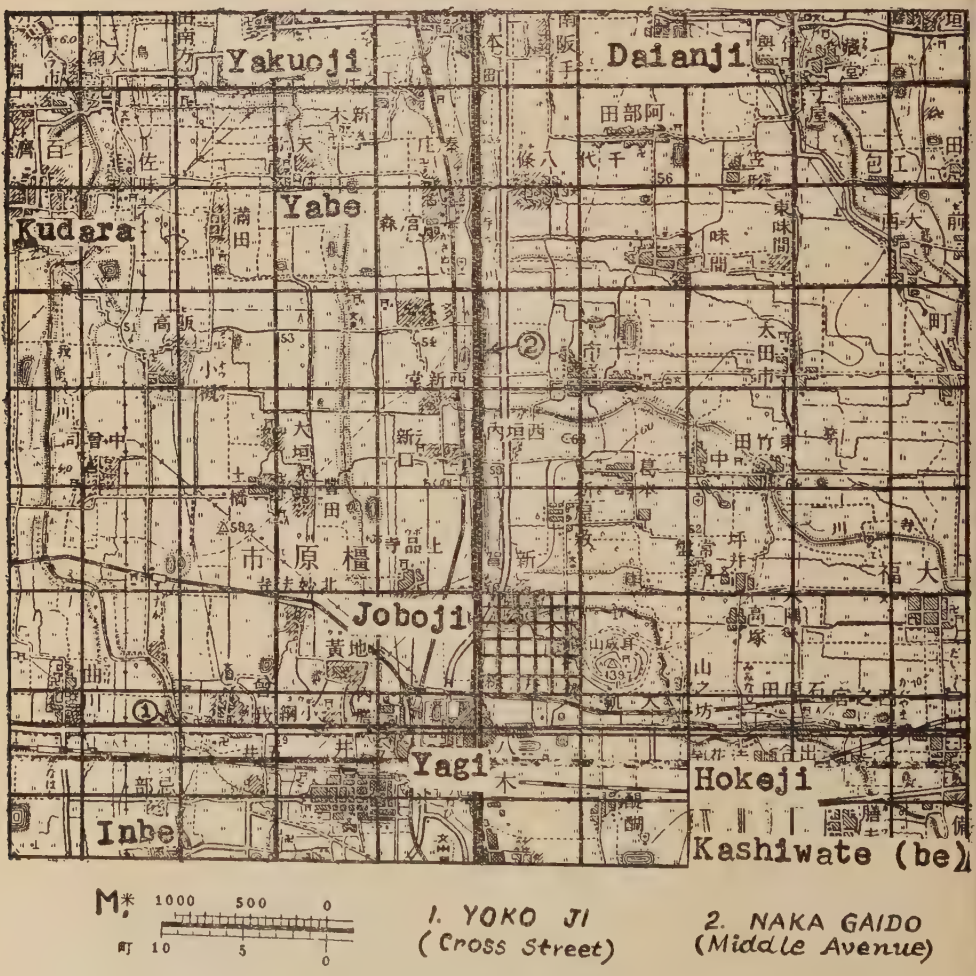

Fig. 2. Nara Basin

The Chinese square pattern land allotment system spread over other countries in East Asia It was introduced in Japan in the

seventh century. In Yamato or Nara basin, which was the centre of old Japan, the system was put into practice to the full extent.

Fig. 2 shows the southern part of Nara basin. Naka Gaido (middle avenue), the north-south road which runs through the middle of its basin, was the principal meridian, and Yoko Oji (great cross street), the east-west road crossing the Naka Gaido at Yagi town in the southern part of the basin, was the other base line. The basic unit of allotment, called Ri was about 720 metre square. It was divided in 36 sections. One section is 1·2 hectare or 3 acres. This section probably represented one family's holding, as that of the Fu section in the Tsing-t'ien system. Thus one Ri must have been an ideal village area containing about 30 families in Japan. This allotment system is called Jori system from its numbering method Jo and Ri as co-ordinates.

We can see agglomerated villages distributed almost with the same intervals. These villages have ordinarily two or three sections as settlement areas which are divided by small lanes.

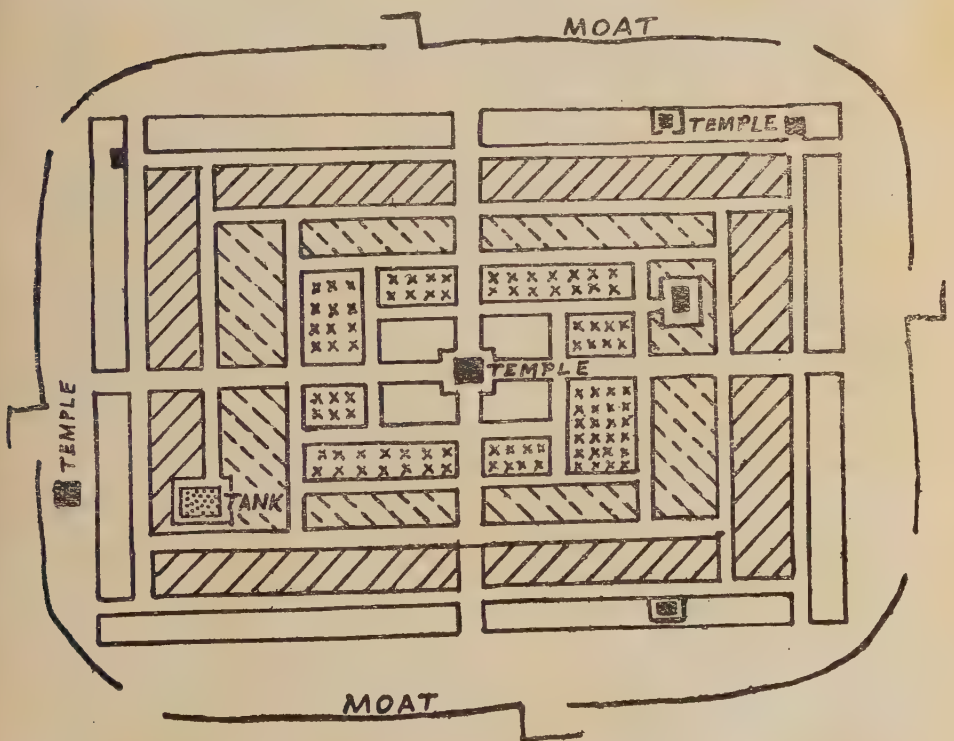

Fig. 3. Nandyavarta. Hatches indicate segregation of castes.

In India there is one classic, Manasara Silpasastra[9], which was compiled in fifth or sixth century A. D. but it contains many old

traditions. In this classic, eight types of village planning are described. They are all planned in rectangular form with two main streets running correctly east-west and north-south, crossing each other at right angles. In the centre of the village there is a planned temple or hall. Fig. 3 is of the Nandyavarta type. Four quarters were sub-divided by lanes parallel to the main streets. Tank was located at a convenient spot.

We find many villages which would be settled following 'Manasara-Silpasastra' types in south India, from Deccan plateau to Coromandel coastal plains.

Fig. 4 shows the centre of village Pimpal Nilahk, western suburb of Poona. It stands along the Mula river. In the centre of the village there is one banyan tree which gives shade to villagers and on the opposite side there is a temple, half of which is now used as a school. The road between the temple and the tree runs east-west. This photograph was taken at the entrance of the village which is situated at the east end of the main road to the direction westward. Another temple is also here. A little apart are the houses of the untouchables down the stream.

Fig. 5 shows village Banere. It is situated a mile down stream from village Pimpal Nilakh. There is one isolated hill, may be a mesa, on the south of the village. In the centre there is temple and a place with banyan tree. The roads run east-west and north-south. Southernmost part of village is inhabited by fishermen.

Fig. 6 shows the centre of the village Nundambakham, southern surburb of Madras. Here we see square shaped tank and walled temple. At one corner of the tank there stands a large banyan tree.

Fig. 7 shows Nundambakham Chari which is a hamlet of untouchables situated a little northward.

Fig. 8. It is a village named Lalgudy lying northeast by north in the suburb of Tiruchchirappalli. There is a large walled temple in the centre of the village. Four streets facing the temple wall are inhabited by Brahmans who form the land owning caste.

Fig. 9. It shows south street with one Brahman family in front of their house. The roads cross, making cross roads, some time in the shape of alphabet T. This kind of road system is suggested in Manasara Silpasastra as types known as Nandyavarta and Swastika.

Figs. 10 to 13. These are pictures of village Avaniyapuram, three


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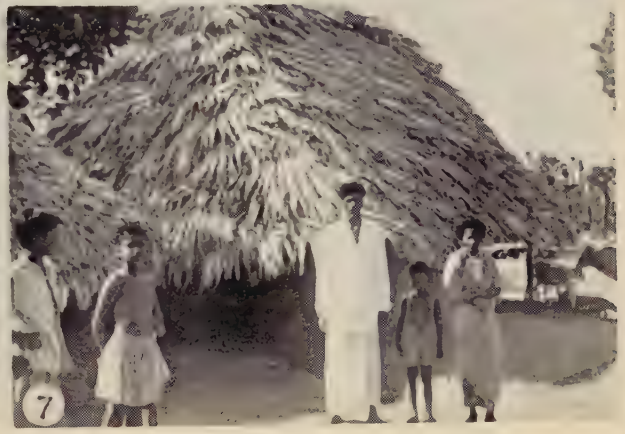
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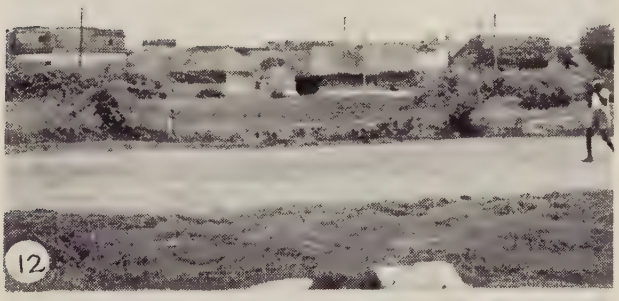

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miles south of Madurai. Fig. 10 shows the central cross roads. Highway from Madurai passes from left (north) to right (south). The picture was taken from west to eastward. In the open place, the maidan is situated. At the corner, there is a temple to the western side of the highway. Fig. 11 shows its northwest corner. In the maidan there is a hall for villagers ; village office also faces the maidan. There is also a bus stop. Along central north-south highway shops line up. It presents a somewhat urbanized scene. Going along the highway a little northward, there is a cluster of huts. These belong to untouchables. Fig. 12 is the general view. Fig. 13 shows the lane inside. The plan is quadratic as in the mother village. Because the ground slopes gently northward, the untouchables' huts stand downstream from the mother village.

In northern India, early Aryan villages were transformed by successive natural and political disturbances. In southern India, villages had a more peaceful history and Hindu civilization was preserved better. That is the reason why the ideal village types of the Aryan race have been retained in south India.

Social structure affecting the village pattern

This subject may belong to a sociologist or anthropologist more than to a geographer. We have many books and papers concerning the social structure of India's village[10].

An Indian village is ecologically a symbiosis of different castes. Each caste used to have their quarters within the village. Though not always, high castes usually occupy the best quarter in the settlement area, for example, the central part or the place which can receive prevailing wind first. The lower castes occupy peripheral parts and untouchables live a little apart from the mother village.

About the origin of castes, there are many theories, but my feeling has been that, we can also give a hygienic geographical reason. As India has tropical climate many epidemic diseases would have prevailed in ancient times as in the present day, and advancing Aryan tribes would have found from long experience that they could keep better health when they took their food cooking themselves not allowing aboriginal servants to cook, and also when they touched aboriginals, they would catch many skin diseases. These facts stimulated the idea of religious pollution and strengthened the segregation which combined with many other reasons helped in time to form the caste system.

In Japan, there are so-called unliberated villages. These villages resemble the untouchables in India ; though the total population of unliberated villages in Japan is negligibly small when compared with Indian untouchable population. Japan's unliberated population for example deal with dead bodies of animals, skinning these for the leather. Some are makers of baskets of bamboo strips.

The origin of unliberated villages is obscure. In ancient Japan there were many occupational castes. They were called Be, Sub-be (potters), Hatori-be (weavers) and Tamatsukuri-be (jewellers and polishers) and so on. Many of them were immigrants from Korea and China. So at first they would have had racial characteristics.

Their social status was somewhat akin to half slavery. Each Be lived by themselves forming independent villages. So even now there are many villages which have ancient Be names. (Fig. 2). Occupational Be castes belonged to local chiefs.

On the process of the unification of Japan, the Chief of Yamato, the ancestor of the ruling royal family, appointed nobles as the heads of each occupational castes and governed them directly under the Yamato sovereignty.

After unification of Japan in 646 A.D., these castes were liberated. But powerful Buddhist temples were permitted to keep them. This would have some relation to the unliberated villages of present day Japan.

Of course officially unliberated villages have been liberated since the end of nineteenth century but actually social discrimination, especially in marriage, is even now strict. So the government and social workers are eagerly working for their true liberation.

Their settlement pattern is a little different from the untouchable hamlet in India. Japanese unliberated villages form independent villages but their humble houses crowding in confusion resemble Indian untouchable hamlets very much.

Conclusion

I discussed the general characteristics of Indian villages, in external village pattern and in internal village structure. There are more resemblances between India and East Asia than between India and West Europe. The comparative study of Indian villages with East Asian villages is important not only from academic point of view but also for very practical purpose of improve-

ment of present village life on both sides. Agriculture in India is composed of cattle-breeding with intensive crop cultivation. I was deeply impressed by many families in Indian villages who have nice courtyards for keeping many kinds of cattle. Sometimes they are bigger than human dwelling places. In Japan, villagers and politicians are trying to adopt dairy farming and are studying mostly western way of cattle rearing, but I think they must turn their eyes to Indian villages. They will have many things worth to learn especially how to keep cattle by practising intensive crop cultivation.

Indian Government and Indian farmers are eager to adopt the method of Japanese rice cultivation. But to spread it to larger area, it will need some modification to suit Indian agricultural system. About liberation of oppressed vilagers we have a common problem. At any rate we have much to learn from each other.

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Prof. N. K. Bose, Director Anthropological Survey of India, kindly looked through the manuscript for which the author is grateful to him.

PATTERN OF IN-MIGRATION IN INDIA'S CITIES[1]

Amrit Lal

Population movements, in-migration and out-migration, are significant though neglected factors in the geographic studies of areas and communities in India. These movements are important indices of social dynamics of areas, and they highlight a wide variety of causal relationships with the total physical, biotic and cultural conditions prevailing therein[2]. The pattern of in-migration in the cities is not only related significantly to their growth, their labour-force participation, sex and age structures, consumption and housing needs but also has an important bearing on several social problems of the cities. This paper attempts to analyse and interpret some of the salient features of in-migration in cities of India in 1951[3].

Rural-urban migration has been an important factor in promoting the growth of urbanization in India as it has been in other countries[4]. Transfer of a substantial number of persons from agricultural pursuits in the rural areas to nonagricultural services and industries in the urban areas has been largely responsible for this rural-urban migration in India[5]. This movement of population got a remarkable fillip after 1931, and particularly during 1941-51, when the population of the cities grew at a very rapid rate[6].

The information on in-migrants in the Indian cities is derived from the indirect source of the place-of-birth statistics of their

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1 Cities, according to the Census of India 1951, are defined as the urban localities which consist of towns and town-groups of 100,000 or more inhabitants in 1951. See *Census of India*, Vol.1, part II-A, p.62.

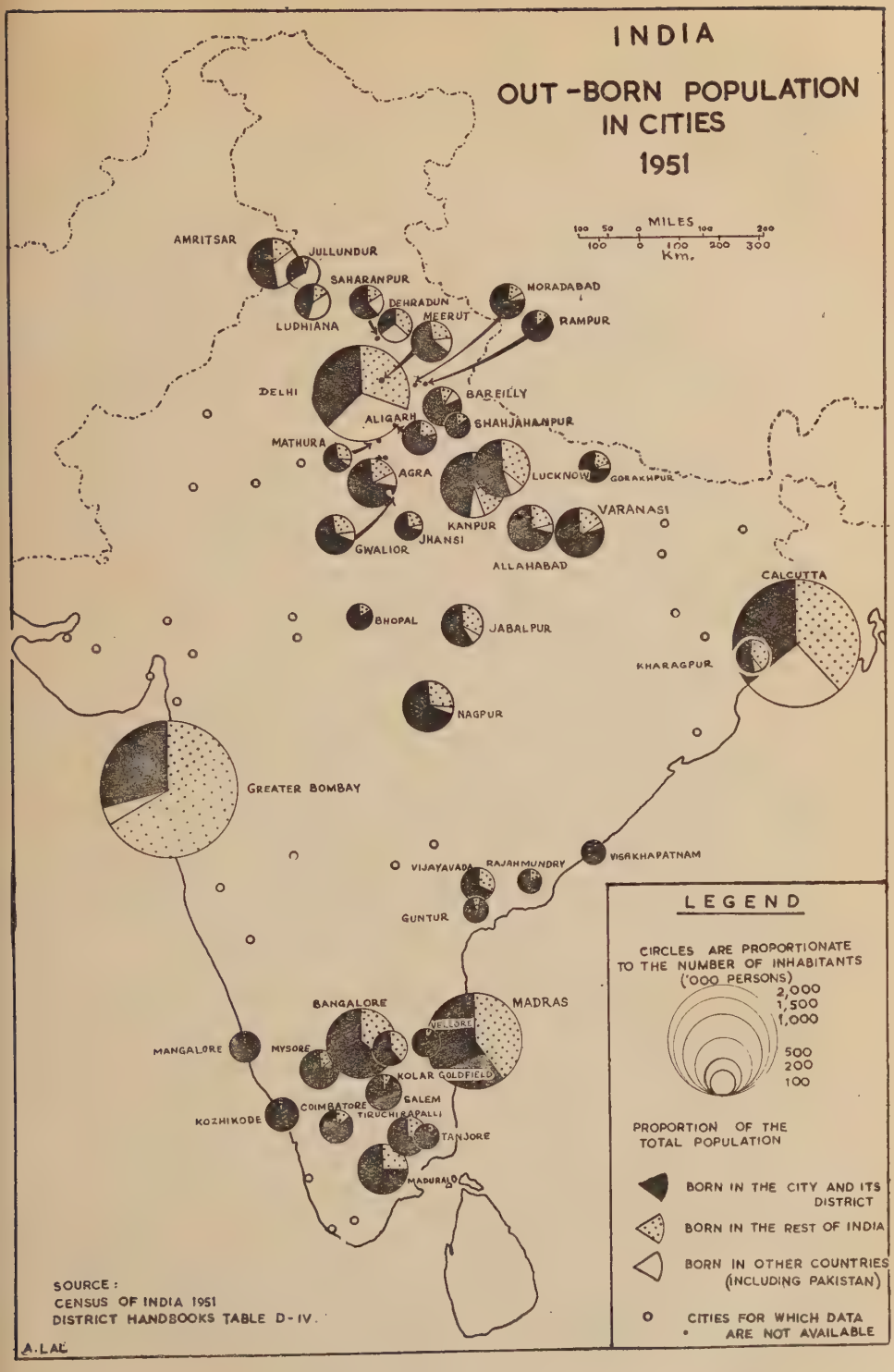
2 Preston E. James and Clarence F. Jones (editors), *American Geography : Inventory and Prospect*, (Syracuse, N.Y. : Syracuse University Press, 1955), p.108.

3 For want of data, the study is confined to only 43 of the 71 cities, as defined above.

4 R.I. Crane, "Urbanism in India", *American Journal of Sociology*, 66 (1954), p.467.

5 S. Chandershekhar, *India's Population : Facts and Policy*, (New York : John Day and Co., 1946), p.31.

6 For a detailed analysis of the regional variations in the growth of 71 cities of 1951 through a period of 50 years, see A. Lal's "*Some Characteristics of Indian Cities of over 100,000 inhabitants in 1951, with special reference to their Occupational Structure and Functional Specialization*", Ph.D. Thesis, unpublished, (Bloomington : Indiana University, 1958), pp. 15-24 and pp. 148-169. (Microfilm available from University of Michigan, Ann Arbor).


INDIA
OUT-BORN POPULATION IN CITIES
1951
MILES
100 50 0 100 200 300
Km.
AMRITSAR
JULLUNDUR
SAHARANPUR
LUDHIANA
DEHRADUN
MEERUT
MORADABAD
RAMPUR
DELHI
BAREILLY
ALIGARH
SHAHJAHANPUR
MATHURA
AGRA
LUCKNOW
GORAKHPUR
KANPUR
JHANSI
GWALIOR
VARANASI
ALLAHABAD
CALCUTTA
KHARAGPUR
BHOPAL
JABALPUR
NAGPUR
GREATER BOMBAY
VISAKHAPATNAM
VIJAYAVADA
RAJAHMUNDRY
GUNTUR
BANGALORE
MADRAS
VELLORE
MANGALORE
MYSORE
KOLAR GOLDFIELD
SALEM
COIMBATORE
KOZHIKODE
TIRUCHIRAPALLI
TANJORE
MADURAI
LEGEND
CIRCLES ARE PROPORTIONATE TO THE NUMBER OF INHABITANTS ('000 PERSONS)
2,000
1,500
1,000
500
200
100
PROPORTION OF THE TOTAL POPULATION
BORN IN THE CITY AND ITS DISTRICT
BORN IN THE REST OF INDIA
BORN IN OTHER COUNTRIES (INCLUDING PAKISTAN)
CITIES FOR WHICH DATA ARE NOT AVAILABLE
SOURCE :
CENSUS OF INDIA 1951
DISTRICT HANDBOOKS TABLE D-IV.
A.LAL

population in the Indian Census. The Census of India considers the place of birth as the sole test of a person's normal residence and assumes that he or she migrated to the place of enumeration from the place of birth. The data collected at every census, thus show the net cumulative result of all in-migration that has taken place during the preceding decades. Despite the limitations that are inherent in these data[7], these form the only means to assess the amount of in-migration that has taken place in the cities from areas outside the districts in which they are located. It is on the basis of these statistics, as consolidated under the following categories to show three components of the population of the cities, that this paper attempts an analysis of the problem under review :

(a) Persons born in the cities and the districts in which they are located (i.e., roughly speaking the native-born population).

(b) Persons born in the rest of the country (i.e., normal in-migrants).

(c) Persons born in foreign lands, including Pakistan (i.e., in-migrants under special circumstances).

The persons enumerated under (b) and (c) categories above can provide the basis for estimating the extent of in-migration in the cities ; however, persons under (c) form an abnormal type of in-migration in some cities of north India mainly, where displaced persons from Pakistan came to settle after the partition of the country. Such an abnormal and unprecedented in-migration may, therefore, be excluded from the scope of this paper which is concerned with the features of normal in-migration in the cities of different parts of the country.

VARIATIONS FROM CITY TO CITY : In 1951 the median proportion of population that was born in the rest of the country in 43 cities was 20·4 per cent. The mean value for these cities was 34 per cent. In particular places, the proportion varied from

7 No distinction is made between permanent and temporary in-migrants in the cities ; moreover, these statistics do not discriminate between persons born within the cities and those born in the Districts in which those cities are located. This defect alone makes impossible any estimate of the amount of migration to the cities from the rural and urban areas within the same district in which a city is located. This short-distance migration is likely to form an important component of in-migration, specially in the small cities which attract more in-migrants from shorter distances as compared with the large cities.

3 per cent in Kozhikode in the south zone to 66 per cent in Greater Bombay in the west zone[8] (Fig). All the large cities, with a population of over 450,000, tend to have a higher proportion of the out-born persons as compared with most of the smaller cities. Thus, Greater Bombay, Calcutta City[9], Madras, Bangalore, Kanpur, Lucknow, Nagpur and Delhi, all derive more than one-fourth of their population from outside the districts of their location[10]. On the contrary, in most of the smaller cities, with the exception of Kharagpur, Kolar Goldfields, Dehra Dun, Jabalpur, Vijayawada, Gwalior and Mathura, the proportion of the out-born persons in their population is less than 25 per cent. However, it should not be taken to mean that there is any close positive correlation between size and in-migration[11].

RELATION WITH FUNCTIONS : The place-of-birth data are not adequate for seeking any refined relationships between the functional specialization of cities and the rate of in-migration. Two reasons may be cited for this inadequacy : firstly, data are not available for all the cities, and even those that are available provide only an indirect measure of in-migration ; secondly, there has been an exodus of the Moslem citizens during the post-partition disturbances from several cities of north India and there are no means to check the changes introduced by that exodus in the proportion of out-born population in those cities. Despite these limitations, however, there are indications to show that functions and the nature of functions, exercise a considerable influence on the proportion of in-migrants in the cities' population. The cities that specialize in public administration (particularly in military services) and/or transport (mainly in railways) have usually higher proportions of out-born population. In both these

8 For a detailed discussion of the distribution of cities within the five zones of India refer to Lal, *op.cit.*, pp.24-25.

9 Comparable statistics were available only for Calcutta city proper (population : 2,548,677 in 1951), excluding the rest of the towns in the conurbation

10 Data on the place-of-birth of the population of three large cities—Hyderabad, Ahmadabad and Poona—are not available for 1951. In 1931, about 31 per cent and 37 per cent of the population of Hyderabad and Poona respectively were born outside the districts of their location. There is every reason to infer that, in view of their rapid growth since 1931, these proportions of the out-born population would be at least the same, if not higher

11 On basis of an analysis of 1931 statistics, Kingsley Davis also alludes to a not too strong tendency for the proportion of out born population to be higher in the larger cities. See Kingsley Davis, *The Population of India and Pakistan* (Princeton, N.J : Princeton University Press, 1951), p 134.

services most of the workers engaged are transferred from one centre to another, and they are seldom native-born. Thus, out of 15 cities of less than 450,000 inhabitants, where the proportion of out-born population exceeds the median value of 20·4 per cent, 12 are important centres of railway and/or military administration, viz., Tiruchchirappalli (railway centre), Jhansi (rail-cum-military centre), Meerut (military centre), Dehra Dun (military centre), Jabalpur (military-cum-railway centre), Vijayawada (railway centre)[12], Mathura (military-cum-railway centre), Gorakhpur (railway centre), Rajahmundry (railway centre) and Allahabad (railway and military-cum-civil administration centre). Kolar, Mysore and Madurai are the only exceptions since they have an above-median proportion of out-born population but are not important as centres of transport or public administration. Kolar's large out-born population may be due to the peculiar labour requirements of the gold mines which could not be fully satisfied by the local unsk lled labour force in a backward district. Moreover, a large number of persons engaged in different urban services had also to be brought from other districts. In the case of Madurai and Mysore, the growth of manufacturing industries may have been one of the important factors for attracting migrants from outside.

A few cities that have a high relative employment in public administration and/or transport have at the same time a low proportion of out-born population, viz., Ludhiana, Saharanpur, Jullundur, Bareilly, Agra, Vishakhapatnam and Kozhikode. With the exception of the last two cities, all others have undergone considerable changes in their population composition after 1947 on account of the Indo-Pakistan transfer of population. The census statistics of out-born population in these cities (excluding the refugees from Pakistan) in 1951 do not give any idea about the changes introduced by the exodus of Moslem citizens[13]. In the case of Vishakhapatnam and Kozhikode(Calicut), their high relative employment in transport is mainly due to their port functions ; the port workers, usually derived from the same district, are more or less permanent residents of these cities and are not

12 The high proportion of out-born population in Vijayawada may be partly explained by a large influx of refugees from the former princely state of Hyderabad during the constitutional and civil crisis in 1947-49, before the State was integrated with India.

13 It is likey that the pre-partition proportion of out-born population in these cities might have been higher on account of the presence

likely to be transferred from other ports, unlike the employees of the Indian Railways.

CAUSES OF MIGRATION : The main reason for rural-urban migration is the economic pull of the cities ; some of the minor factors are the facilities for education, medical care, recreation and the freedom and galore of city life. Specific field studies would be required to assess the importance of these factors in cities of different types. A recent survey of Poona [14] highlights the importance of various causes for rural-urban migration in the case of a large multi-functional centre of professional services, public administration, education and wholesale trade, coupled with a normal specialization in transport and manufacturing.[15] According to this study, about 70 per cent of the in-migrants came to seek a source of livelihood in the city for one reason or the other ; another 7 per cent came to seek the benefits of educational facilities ; about one-tenth had been transferred to the city by their employers (some of the families in this class continued to stay in the city even when the original reason for their influx had disappeared). The remainder, about 13 per cent of the in-migrants, consisted of displaced persons from Pakistan, persons seeking medical treatment, retired persons and others motivated by a variety of reasons. Thus, the economic opportunities offered by the cities to the under-employed and unemployed persons in the rural areas and in the small towns with limited economic openings for the population are the main reasons for migration to the cities.

RELATION BETWEEN CITY GROWTH AND IN-MIGRATION : As already observed, the rapid growth of the cities' population after 1931 was touched off by a large scale rural-urban migration. Such an increased migration was mainly due to the rapid expansion of manufacturing industries and commerce in the cities, leading to an opening up of opportunities

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of the Moslem citizens, who had migrated in large numbers to Pakistan. A greater proportion of the Moslem citizens of pre-partition days might have migrated from the rural areas where they formed a minority community. Moreover, there was a large number of artisans among the Moslems who may have been attracted to the cities on account of expansion of industries during and before the World War II.

14 N.V. Sovani, *Poona : A Resurvey*, (Poona : Gokhale Institute of Politics and Economics, 1956), pp. 131-32.

15 For a full discussion of the functional types of Indian cities and the intensity of specialization in different urban functions see Lal, *op. cit.*, pp. 55-147.

for employment of depression-striken people in the rural areas and in the small agricultural marketing towns. No specific data are available to enable a study of historical trends in the rate of rural-urban migration and its relation with the growth of population of individual cities. Therefore, the data available for Calcutta city proper (excluding other urban areas within the conurbation) may serve to illustrate how the rapid and accelerated growth rate of the city's population is directly related to an increase in in-migration after 1931 (Table). The growth of Calcutta was rather slow until 1931 as the number of

TABLE.

IN-MIGRATION AND OUT-MIGRATION IN CALCUTTA CITY PROPER FROM AND OUTSIDE THE STATE OF WEST BENGAL SINCE 1901.

	1951	1941	1931	1921	1911	1901
Actual Population (in '000s)	2,549	2109	1,141	1,032	998	921
Percentage Change	+20·8	+85·0	+10·5	+3·4	+8·3	...
Out-migration (in '000s)	44	26	22	46	34	3
In-migration (in '000s)	1,389	690	379	371	397	325
Natural Population (in '000s)	1,204	1,445	784	706	635	599
Percentage Change in the natural population	−16·7	+84·2	+11·1	+11·2	+5·9	...

Source : *Census of India 1951 Calcutta City*, Vol. VI, part III (Delhi : Manager of Publications, 1954), p xviii.

in-migrants during the preceding decades did not show any substantial increase ; in fact there was a slight decrease in the number of in-migrants during 1911-21 and 1921-31 on account of a depression in the city's work centre. The great increase in the number of in-migrants registered in 1941[16] and 1951 owes much to the vastly improved prospects of employment offered by the city during World War II and the post-war boom. The statistics for in-migrants in 1951 are greatly inflated by unprecedented influx of displaced persons from Pakistan, numbering

16 The large increase in the 'natural' population during 1931-41 as shown in the Table seems hardly natural. There must have been some artificial inflation of numbers by different communities in the 1941 Census ; secondly, there may be some in-migration from the adjacent urban places within the conurbation—a migration that is not shown by the figures for in-migration

over 433,000. A decline in the natural population of the city during 1941-51 may be partly due to the exodus of Moslem citizens to Pakistan and partly due to a movement towards the suburban towns from the central city after the war.[17]

SEX RATIO OF THE IN-MIGRANTS : In-migrants exert great influence on the age and sex structure of the cities, apart from accelerating their rate of growth. A distinctive characteristic of the rural-urban migration in India is the high proportion of males among the in-migrants. On the average there are only 610 females for every 1,000 male in-migrants in the 43 cities under consideration. In particular cases, the number of females varies from 352 in Amritsar to 1,149 in Salem. There is a tendency for the large cities of over 450,000 inhabitants to have a low proportion of females among the in-migrants. For example, the number of females for every 1,000 males among the in-migrants in Calcutta (376) Bombay (575), Kanpur (541), Lucknow (701), Delhi (751), Bangalore (790) and Nagpur (795) is below the median value of 800 for the 43 cities. Madras (816) is the only exception among the large cities where the sex ratio of the in-migrants is higher than the median value, although, the departure is only slight. In the case of smaller cities, the variation in the sex ratio of the in-migrants does not follow any definite pattern, except that the values are relatively higher in the cities of the South[18], and secondly, the cities with a large relative employment in the armed forces have, for obvious reasons, more males among their out-born population, as compared with other cities.

CONCLUSIONS : The cities have grown very largely through a male-dominated adult in-migration. The incomplete and indirect data that are available show some tendency for the large cities, especially those or 450,000 or more inhabitants, to have high proportions of in-migrants. Among other cities, those with a large relative employment in railway transport and public administration have a large proportion of in-migrants. A search for a more refined relationship with either growth rates of cities or functional specialization would require more comprehensive and precise data than what are available.

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from the rest of the state of West Bengal and India Moreover, chances of some tabulation errors may not be completely ruled out.

17 A Mitra, *Census of India 1951, Calcutta City*, Vol VI, part III (Delhi : Manager of Publications, 1954), p. xviii.

18 There is a widespread belief, supported by some field studies, that in-migration in the cities of South India is largely a family affair in contrast to the single man migration in the cities of North India. See Gertrude M. Woodruff's interesting article "Family Migration into Bangalore", *Economic Weekly*, Annual, Vol. 12 (1960), pp. 163 72.

VEGETABLE MARKETS AND REGIONAL RELATIONSHIP OF HYDERABAD CITY

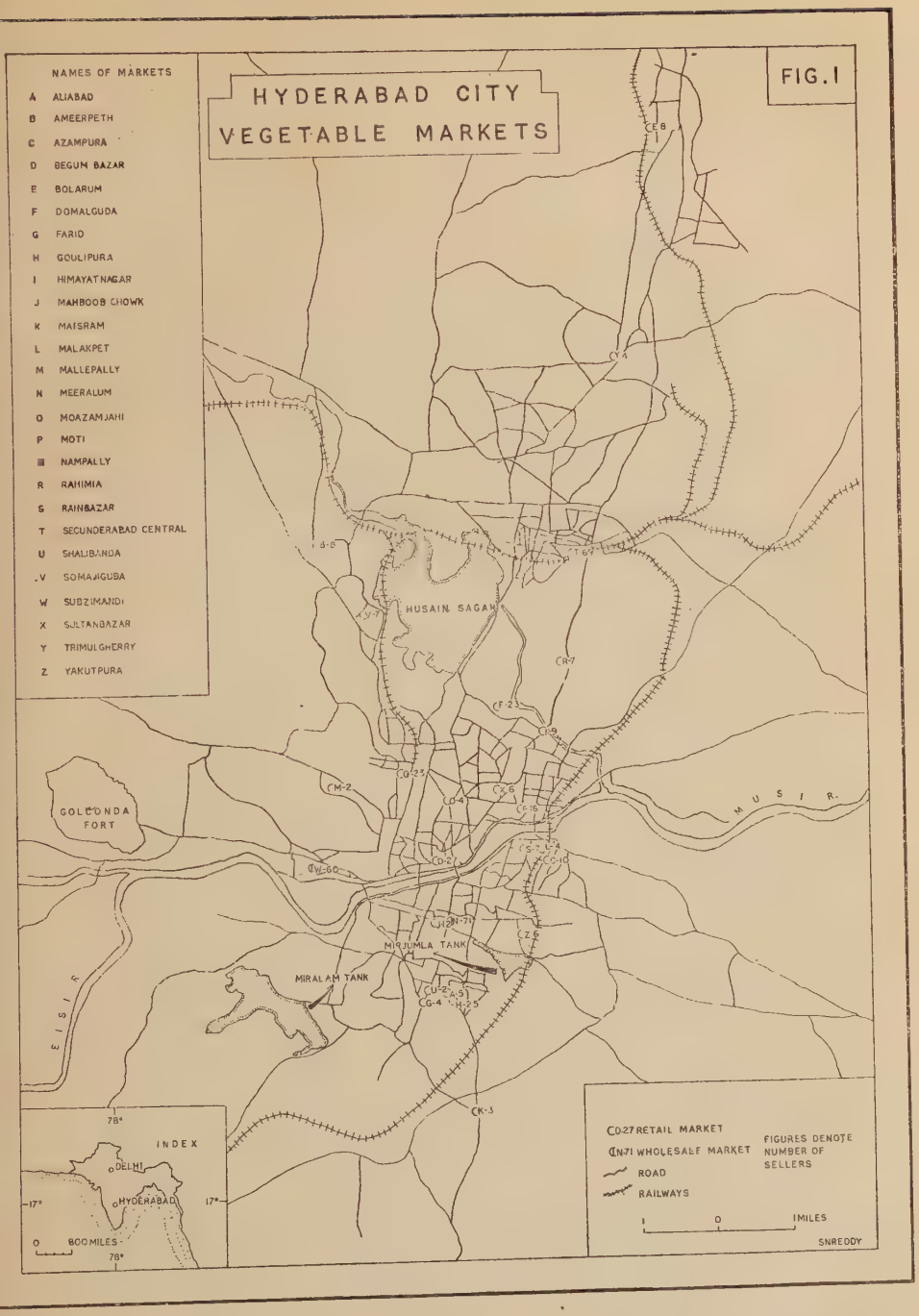
Satya N. Reddy

Geographers in general and Indian geographers in particular, have given scant attention to the study of regional relationship of urban settlements as expressed by supply areas of different commodities consumed by the urban population. A few studies of this kind have been made by Singh (1955, pp. 119-120). Among commodities for daily needs the food products are the most significant, and in a country like India where the production of milk is extremely low, it is vegetables which are the main sources of nutritional elements. Within a town itself the production of vegetables is sharply limited and it is only from the surrounding region that it gets its daily supplies. The types of vegetables grown, the routes through which these move into the city markets, the distribution of the markets within the city and other related facts enable us to understand the regional relationship of a town. The object of this paper is to describe and interpret the regional relationship of Hyderabad City, using the retai land wholesale vegetable markets as its indicators

Location :

Hyderabad, the fifth largest city of India, is situated on 17° 22′ north latitude and 78° 27′ east longitude. Founded in 1589 on the right bank of river Musi (Fig 1), a tributary of the Krishna, it gradually spread to the left bank and grew to a large city during the Asafjahi rule (18th to 20th century). Its situation on the banks of the Musi, however, is of no economic significance as the river has never been used as a line of transport, nor has its water been used to any extent for the production of vegetables Perched in the centre of the Deccan Plateau nearly 1700 feet above sea level, Hyderabad with its twin city, Secunderabad, sprawls over an area of 96 sq miles. Geologically the region belongs to the Deccan granitic formations, a fact which is of supreme significance in explaining the extent of land with high mineral content which itself is an important element in the physical base of vegetable production.

Hyderabad is adequately connected with both the larger towns of India as well as with the area on which it depends for its daily supply of vegetables. It is connected by railway of both broad and meter gauges, and by all kinds of roads with


HYDERABAD CITY
VEGETABLE MARKETS
FIG.1
NAMES OF MARKETS
A ALIABAD
B AMEERPETH
C AZAMPURA
D BEGUM BAZAR
E BOLARUM
F DOMALGUDA
G FARID
H GOULIPURA
I HIMAYATNAGAR
J MAHBOOB CHOWK
K MAISRAM
L MALAKPET
M MALLEPALLY
N MEERALUM
O MOAZAMJAHI
P MOTI
Q NAMPALLY
R RAHIMIA
S RAINBAZAR
T SECUNDERABAD CENTRAL
U SHALIBANDA
V SOMAJIGUDA
W SUBZIMANDI
X SULTANBAZAR
Y TRIMULGHERRY
Z YAKUTPURA
HUSAIN SAGAR
GOLCONDA FORT
MUSI R.
MIR JUMLA TANK
MIRALAM TANK
INDEX
DELHI
HYDERABAD
78°
17°
0 800MILES
RETAIL MARKET
WHOLESALE MARKET
FIGURES DENOTE NUMBER OF SELLERS
ROAD
RAILWAYS
0 1MILES
SNREDDY

the vegetable producing area (Fig. 2). However, it is the roads that play the most important role in collecting the vegetables from the surrounding region, bringing them to the various markets within the city and distributing them to the various consuming areas within it. Thus, it is the roads which forge and maintain the essential link in the regional relationship of Hyderabad.

Historical Background :

Historical records do not provide any definite data to reconstruct the historical evolution undergone by the vegetable markets of the city. Suffice it to say, that vegetables have always formed an important part of daily diet of the urban population. Telugu (the native language of Hyderabad) words for all the indegenous species and varieties of vegetables definitely indicate that they always formed an important part of the diet. From oral enquiries, it was found that the three wholesale markets of the city (Fig. 1) forming the nucleus of its vegetable marketing are much older than the present retail vegetable markets. However, it soon became evident during field work that some of the three wholesale markets really evolved from the earlier retail markets. It is interesting to note at this point that it is these wholesale markets which act as the intermediary agents between the retail vegetable markets and the sources of production of the vegetables, and thus, these really form the basis of the regional relationship of the town. The oldest of these wholesale markets is the Subzi Mandi (Fig. 1), which has been in existence since the time of Katub Sahis (17th century A.D.). This market is located on the road between Hyderabad and Golconda fort. Such a location between the the large consumption areas of Hyderabad and Golconda had given it a prominence from the earliest days of its establishment. Although historical records are silent on the origin of this important market of the city, it is most probable that it evolved from a retail vegetable market by becoming more complex in its economic structure. The initial momentum to its development given by its exellent productive location was later on reinforced by the roads which pass through it connecting Hyderabad with Mahbubnagar, Vikarabad and Patancheru, which supply a large quantity of vegetables (Fig. 2). The fact that the railway stations are far off from Sabzi Mandi (Secunderabad 6 miles, Nampalli 3 miles,

Kachiguda $3\frac{1}{2}$ miles), does not in any way affect the development of this market, since the railways do not feed it with vegetables.

Not the oldest but the biggest wholesale vegetable market in the city is the Meeralum Mandi (Fig. 1) with an average daily sale of about 2,000 maunds. It was established by the Prime Minister of Hyderabad State, Mir Alam, between 1804 and 1808 A. D. to function as a distributing centre of doles to the famine stricken population. Subsequently it became a vegetable market. The market has grown considerably in recent times and presents a very conjested appearance with jam-packed conditions during business hours. The roads between Hyderabad and Ibrahimpatam, Nalgonda and Bhongir move the vegetables into this market (Fig 2).

The Secunderabad Central market has had a simple history of its origin for vegetable marketing and its establishment in the early periods of catonment administration. It is the youngest one of the three wholesale markets. It is situated just within half a mile from the railway station. The roads leading from Patamcharu, Shamirpet and Medchal (Fig. 2) bring vegetables to this market. It is the only market in the whole city served by both rail and road but its location away from the most populous consuming areas limits its economic growth to a considerable extent.

Spatial Structure :

The wholesale markets, situated at great distances from each other, exist as isolated nodes. Contrary to the expected pattern, we find these markets without the surrounding ring of retail shops. Subzi Mandi, located at one corner of the city, is not dependent on the retail markets for the distribution of its vegetables. The sellers of the retail markets are accustomed to purchase from the old markets and the factor of distance is generally ignored. More interesting is the role played by the personal whims of the individual buyer who, resides in Somagiguda or Musheerabad and buys his vegetables, at Secunderabad market located at a distance of 5 miles from the place of residence. More often than not, they also buy from Subzi Mandi and Meeralum Mandi which fact again indicates the secondary importance of distance in the spatial structure of the consumer areas. On occasions the dealers in the retail vegetable markets of Hyderabad buy the vegetables from the Secunderabad

market, particularly potatoes. Railways are seldom used by the dealers buying from Subzi Mandi and Meeralum Mandi but those at Secunderabad market transport vegetables by railway to the suburban markets of Tirmalgherry and Bolarum. Except this small quantity of vegetables most of it is transported in cycle rickshaws. The retail vegetable markets in the old city are located close to one another probably in response to the demands of the original neighbourhood areas. However, the recently developed colonies of the city have not been able to attract and maintain a retail market. It, therefore, indicates that the historical factor has also been important in the establishment and development of retail vegetable markets.

The wholesale markets have evolved from the older retail markets, and have acquired a specialization. As the population and consequently the demand for vegetables increased a retail market multiplied its business but the producers instead of selling in such markets shifted their business through middlemen to the older markets. In the case of Subzi Mandi the disadvantage resulting from its location away from the commercial centres of the city have been more than compensated by the impetus given to it by the wealthy merchants residing in its vicinity during the initial stages of its development. Later, a change in the site took place and the previous one with a small market house was abondoned, because of congestion, for an open courtyard about a hundred yards west of the previous site.

The Meeralum Mandi located in the heart of the old city (Fig. 1) was established to serve the entire city. In the pre-railway era its location was made nodal by the principal roads converging at the centre of the city. In recent times the population potential for vegetable consumption has shifted to the left bank of the Musi but because of the strong sentimental attachment of the people, Meeralum Mandi has continued to function at the same old site.

The last of the wholesale markets, the Secunderabad market specializes more in the retail selling than wholesale. This is a clear evidence showing that this market has not evolved in the same pattern as the Subzi Mandi and Meeralum Mandi. In course of time when the number of retail markets in the Secunderabad area will have increased, the Secunderabad wholesale market will shift its specialization from the present wholesale-cum-retail to wholesale business.

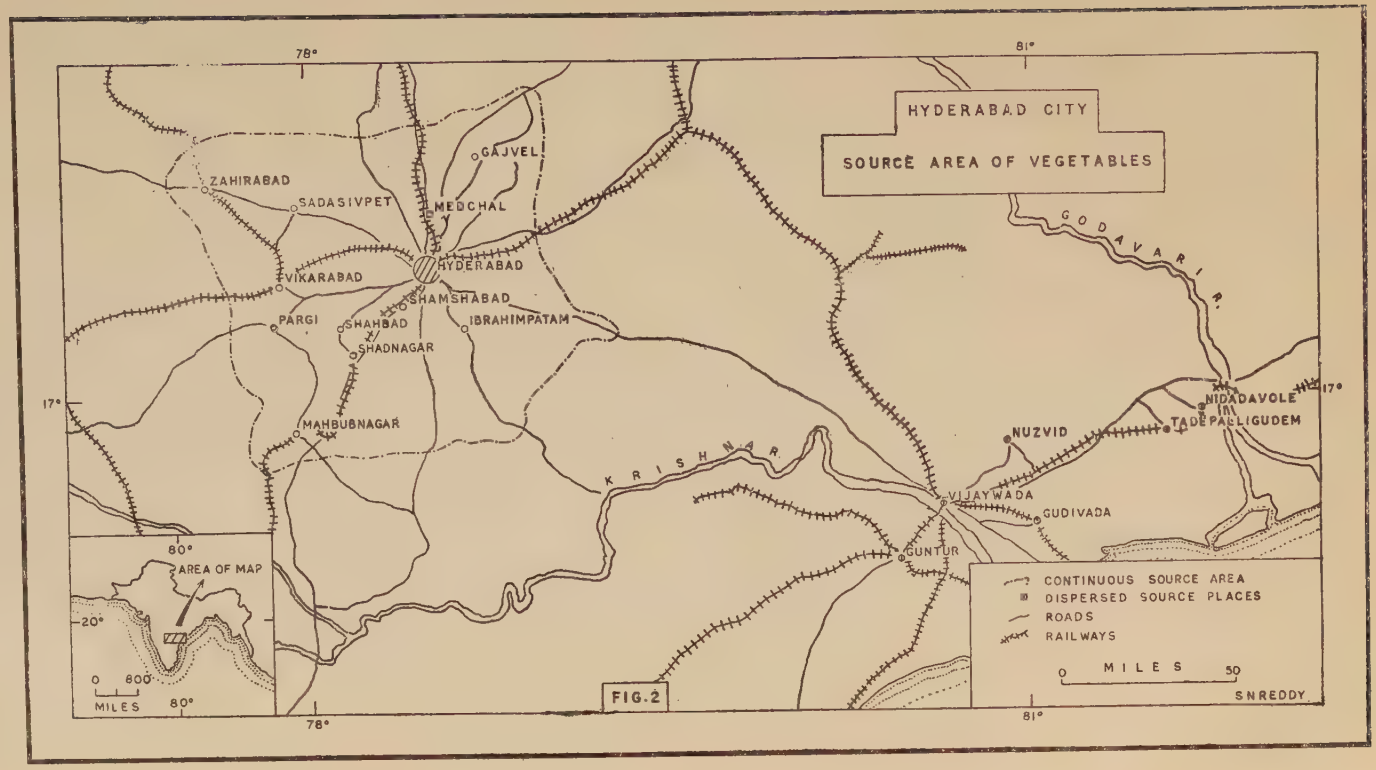

78°
81°
HYDERABAD CITY
SOURCE AREA OF VEGETABLES
ZAHIRABAD
SADASIVPET
MEDCHAL
GAJVEL
HYDERABAD
VIKARABAD
SHAMSHABAD
PARGI
SHAHBAD
IBRAHIMPATAM
SHADNAGAR
MAHBUBNAGAR
GODAVARI R.
NIDADAVOLE
TADEPALLIGUDEM
NUZVID
KRISHNA R.
VIJAYWADA
GUDIVADA
GUNTUR
17°
80°
AREA OF MAP
20°
0 600
MILES
CONTINUOUS SOURCE AREA
DISPERSED SOURCE PLACES
ROADS
RAILWAYS
0 MILES 50
S N REDDY

FIG. 2

Physical Appearance of Wholesale Markets :

These markets differ significantly from each other in their physical appearances. The Subzi Mandi is just an open courtyard with small rooms (malgi) scattered all round. The courtyard itself is a bare ground without any flooring. The malgis are used by the commission agents (*mudidars*) as accounts rooms. The business takes place early in the morning thus eliminating the need for a covered and shady place. The carts bringing vegetables are seen resting on all sides of the courtyard.

The Meeralum Mandi consists of blocks of plinths ($1\frac{1}{2}'$ high, 10′ wide and 20′ long) laid in a rectangular pattern with spaces between them so that the carts could reach each plinth independently. The plinths are provided with sloping tin roofs. There are some malgis on three sides.

The Secunderabad market follows closely the physical pattern of Meeralum Mandi.

Vegetable Varieties and Economic Relationship :

Each wholesale market specializes in the business of some commodities and thus enjoys monopoly in them. It is because of this that the wholesale markets function as complementaries to one another without facing any competition. Again, it is because of this (and personal whims, to some extent, as already explained), that a retail vegetable market has to deal very often with all the three wholesale markets. Subzi Mandi specializes in certain commodities such as *shakarkandi* (sweet potato, *Ipomoea Batatas*), *gajar* (carrot, *Daucus Carota*), *kakdi* (*Cucumis Sarivus*) etc.

In addition to these special vegetables, Subzi Mandi also deals in common with the other two markets with ordinary vegetables such as tomato (*Lycopersicum Esculentum*), *bhendi* (*Hibiscus Esculentus*), brinjal (*Melongena Solanum*) and *kaddu* (*Cucurbita Pepo*). Since the special commodities of this market have only a seasonal supply and the monopoly dependent on them also becomes primarily a seasonal phenomena.

For the specialization in the particular vegetables no explanation was available for which further research, primarily, in the economic structure will be needed.

The Secunderabad market specializes only in potatoes because it is located very close to the railway station and

almost the entire quantity of potato moves by railway. Moreover, this is the only station which is connected with the surrounding region by both broad and metre gauge railways giving it an added advantage.

The Meeralum Mandi does not specialize in any one particular vegetable. Special vegetables of Subzi Mandi and Secunderabad market are bought and sold in lesser quantities in this market, probably because of a smaller supply.

Mode of Transport :

The data about transport show that there is an overwhelming predominance of the carts over the trucks the number of the bullock carts being 310 and that of trucks being 22, coming daily to all the three wholesale markets (data collected personally from Corporation Octroi barriers). The mode of transport has no relationship either with the nature of the vegetable or with the villages of production. Some of the probable explanations may be : the absence of good motorable highways and feeder roads leading to the villages of production, the low economic capacity of both the producer as well as the purchaser to invest in costly motor transport, that some of the perishable vegetables like tomato are grown within a radius of twenty miles and the carts have a range of movement which makes it possible to reach one of the three wholesale markets at the appropriate time for sale and thus the necessity of storing is eliminated, and the inherent conservatism of the farmers to stick to the old mode of transport. During the rainy season, however, the number of trucks form a larger percentage of the total number of vehicles although the number of carts may be still larger than trucks. This is because the trucks have a faster speed and longer range than the carts, which cannot move so easily on many of the unmetalled roads. From the foregoing study of the mode of transport, it becomes clear that although the regional relationship of Hyderabad, based on the vegetable supply, is quite intense, the region itself, dependent on the cart track, must inevitably be small. Some of the distant places do send a considerable quantity of vegetables in motor trucks and since their range of movement is quite long the continuous source region for the combined truck and cart transport spreads over an area of about 8,000 square miles (Fig. 2). This also points to the existence of a nesting heirarchy based on the modes of transport,

one based on carts being contained within another based on trucks.

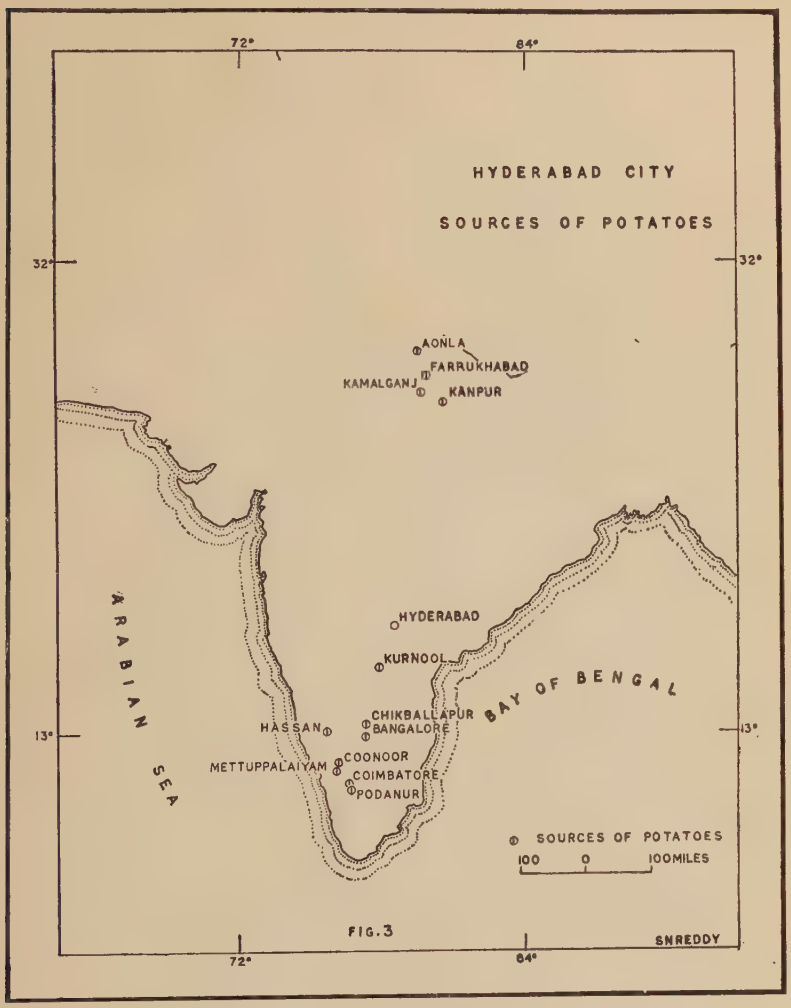
The trucks usually bring vegetables from places over 35 miles away from Hyderabad but many of them come from places as far as 270 miles. Thus, Tadepalligudem, Nidadavole, Gudivada and Vijayawada are connected with Hyderabad by truck service (Fig. 2). So far as railways are concerned their comparative importance is very little as shown by the fact that only about 10 tons of vegetables, on an average, are brought in daily by this mode of transport. The railways bring mostly non-perishable vegetables, mainly potatoes, from places as distant as Kanpur, Farrukhabad, Kamalgunj and Aonla in North India and Mettupalaiyam, Coimbatore, Bangalore and Hassan in South India. (Fig. 3).

Routine and Mode of Business :

The three wholesale markets differ from each other in the routine and mode of transaction of business. In Subzi Mandi the transactions take place early in the morning. The vegetable carts arrive early by 5-30 or 6 A.M. and the commodities are unloaded and kept in heaps on the ground, or if very delicate, in *tokris*. The business starts with the bell rung at 6-15 A.M. when the agents (*mudidars*) begin auctioning the vegetables brought by the producers (*asami*). The business generally reaches the peak by 7 A.M. and closes by about 10 A.M. The Secunderabad market starts by 10 A.M., reaches the peak at 11 A.M. and closes all the transactions by 12 noon, while the Meeralum Mandi starts its business at 11 A.M. and finishes by 4 P.M. The period of business in Meeralm Mandi is about five hours and thus, is longer than those of other two markets. This is so because it is the largest wholesale market and hence transacts the largest amount of business. Moreover, this is the last market where the wholesale dealer transacts his business and thus can devote longer time. Some of the dealers transact business in all the three markets and to enable them to do so the three markets start their business at different times.

Most of the vegetables are weighed and auctioned. Certain delicate vegetables like tomato, which need careful handling, are not weighed at all and sold in lots. The buyers keep regular accounts with the agents and pay them at convenient times. More often than not the producers themselves dispose

off vegetables through their agents, the latter giving the former financial support. The financial relationships between the agent and the producer and the agent and the buyer are maintained throughout a long period of time.



Source Area of Vegetables :

Most of the wholesale markets get their supply of vegetables from areas included within the Hyderabad district. It is a well known fact that most of the large towns in India, as in the western countries, eventually develop a ring pattern of belt around them, which specializes in the growing of vegetables. This is primarily due to a combinations of two factors : the

proximity of the producing area and the perishable nature of the produce. This is still more evident in countries like India, where the total demand for and consumption of vegetables are enormous (India being a predominatly vegetarian country) and the means of transport are not only very inadequate but also very slow besides being prohibitively costly and uneconomic. Such rings of vegetable production surrounding a city are well known to economic geographers (Thunen, 1929, p. 98). A theoretical model of it is provided by Losch (1954, pp. 85-91 .

There are only 19 wholesale shops out of a hundred which get vegetables from outside Hyderabad district. The sources located in the peninsular tract are Medak and Mahbubnagar districts, both being very near to Hyderabad (Fig. 2). The important sources within these two districts are Gajwel, Shadnagar, Medak and Mahbubnagar besides many roadside villages. Of these 19 shops only four get their vegetables from three coastal districts of Krishna, Guntur and West Godavari. It is interesting to note that these four shops attract a much larger volume of vegetables than the other fifteen because they import vegetables in trucks which have a larger carrying capacity. All the other shops, besides the nineteen already mentioned, deal also with vegetables coming from within the district. Hyderabad itself is an important producer as regards the quantity. Such vegetable producing activities are scattered in several localities such as Karavan, Kachi Basti, Meeralum, Mustaiguda, Ambarpeth, Telagadda, Sangam and Musi river bed. These localities produce large quantities of vegetables which are supplied to all the shops of the three markets. The following table gives the number of villages in the continuous source region in categories based on distance :—

TABLE

Distance from Hyderabad.	Number of villages.
Within 5 miles	2
6 to 10 miles	6
11 to 15 miles	13
16 to 20 miles	6
21 to 25 miles	4
26 to 30 miles	4
31 to 35 miles	2

Although this table does not include all the source villages, it is still evident that the majority of them are located at a distance of more than 10 miles of Hyderabad city. This can be best explained as the result of a considerably limited area available immediately surrounding the city. This in itself is the consequence of the land being topographically unsuitable for vegetable production as also of the infertile soil.

There is only one shop in the Secunderabad market which gets the vegetables from outside the state of Andhra Pradesh. Probably proximity to the railway station is the only explanation, because vegetables coming from beyond the state consist primarily of potatoes and they come in trains. The sources for potatoes include Kanpur, Farrukhabad, Kamalgunj, Fazalgunj and Aonla in the Gangetic Plain and Mettupalayam, Bangalore, Coonoor, Podanur, Kurnool and Hassan in the southern part of the Deccan peninsula (Fig. 3). Potatoes coming from all these sources are sold by the same shop since the merchant has specialized in dealing with a single product.

It is interesting to note that the villages producing vegetables do not specialize either in any particular species or variety. So that all the vegetables originate from all the villages. As mentioned earlier, Hyderabad city and its suburbs produce a considerable quantity of vegetables. Most of the vegetables come from outside the district and within the state and only potatoes come from outside the state. All the vegetables coming into the market include both perishable and non-perishable kinds ; those sent from Vijayawada, Nuzvid and Tadepalligudem, arrive in trucks and consist of all kinds of vegetables such as tomato, brinjal, cabbage and *arvi* etc. The produce of the Hyderabad city proper includes the above types but with one difference that the latter has a larger proportion of leaf vegetables.

The continuous source region supplying vegetables to Hyderabad city markets, has an area of approximately 8,000 sq. miles. Such a large area is possibly being maintained only by an intensive net work of roads and railways. However it is the dense net work of road which is more important than the railways. Another reason for such a large source region is, of course, the enormous daily demand for vegetables of the Hyderabad city population. That such distant villages

as at fifty miles away from the city are also producing vegetables is clearly indicative of the regional influence of Hyderabad city. But for Hyderabad such villages, in all probability, would not have produced any vegetable at all, for their local consumption is negligible.

The dispersed sources (Fig. 2) include Guntur, Vijayawada, Gudavada, Nuzvid, Tadepalligudem and Nidadavole. Vegetables originating from these places in most cases move by trucks, since the railway lines do not run straight from Vijayawada to Hyderabad and the road distance is shorter than that of the railway line by about 100 miles. Another reason for the monpoly of truck transport is that it can be used at the convenience of the dealers and it can travel direct from Vijayawada to Hyderabad while the goods trains have a few services, take longer time, and have timings entirely unrelated to the business hours. Such dispersed sources are concentrated into coastal plain in the Godavari and Krishna deltas. Their production of vegetables is primarily due to the fertility of the soil and in the absence of a city with large demand, are sent to Hyderabad. Such discontinuities in the source region have been noted by economic geographers (van Cleef, 1937, pp. 34 to 36). The intervening area between the continuous source region surrounding Hyderabad and the dispersed sources in the coastal districts has the limitation of relative inaccessibility from Hyderabad and the comparative infertility of the soil.

The form of the continuous source region is roughly square (Fig. 2). Such a figure is clearly the result of roads which run in the four cardinal directions and bisecting the four quadrants. Here and there we see some prominent bulges as east of Ibrahimpatam, north of Gajvel and southwest of Mahbubnagar which have been formed by wider roads with greater volume of traffic.

Retail Vegetable Markets :

Although the regional relationship of the city is effected directly and to a large extent through the wholesale vegetable markets, it is the retail markets that act as the essential link between the wholesale markets and the consuming population. Thus, the retail vegetable markets play an important role.

Retail markets are of two types, those which are administered by the Corporation and those which are governed either by

by individuals or by Government. In all there are 26 retail markets of which eleven are municipal, and the rest non-municipal markets.

Most of the markets are found in the older part of the city. This may be due to the economic inertia which prevents the shifting of the markets from the older inner core of the city to the new, less populated outer belt, as well as due to the economic pull of the densest localities of the older part, of the city. Furthermore, the larger number may also be due to the antiquity of the older part, of the city.

The majority of the markets are within one to one and half mile from the wholesale markets. Most of the retail markets were built during the later part of the ninteenth century when they sold not only vegetables but also meat and provisions. In some cases, retail markets have been deserted or half-deserted due to the shift of the surrounding population (like Mallepally and Sultan Bazar markets). The markets in most cases, however, resist locational shifting because of the inertia inherent in the existing site.

All the retail markets are connected with the wholesale markets by a dense network of metalled roads. Most of the retail sellers buy their vegetables twice, in the morning and in the evening from two different markets. Thus, there is a fairly close relation between the retail and the wholesale markets. For the retail sellers the only sources of vegetables are the wholesale markets and the latter control both the amount and price of vegetables in the retail markets. Even the vegetables produced within the city are sent directly to the wholesale markets from where they are distributed to the retail markets. In general the retail sellers of Hyderabad purchase vegetables from Subzi Mandi and Meeralum Mandi while the retailers from the Secunderabad area purchase from the Secunderabad market. All the municipal markets have good buildings specially constructed for them while the non-municipal markets conduct their business in inferior houses. The best stone-built retail market is known as Moazamjahi market. Some markets are held on the government land and some occupy private land or small *malgis*. The muncipal markets are built either in single or double blocks. They are usually enclosed on all sides by walls with one or two gates. The vegetables are displayed in *tokris* and arranged in terraces so that the buyers will have a good look at all the

commodities in the shop. All the market places with permanent buildings have paved floors and are provided with electricity.

The business hours of the markets are regulated by consumers and are usually between seven and ten in the morning and five and eight in the evening and as the consuming population consists largely of office workers, these business hours are most suitable for them.

The method of rent collection varies from one market to another and usually it is between Rs. 3/- and Rs. 9/- for each block. In the private markets it might go upto Rs. 10/-.

The castes represented in the retail sellers are also indicative of the regional relationship of the city. Out of a random sample it was found that 216 sellers belong to one of the Hindu castes and only 44 belong to Muslim group. Among the individual castes seven are Maratha, 57 are *Mala* and *Madiga* (Schedule castes) while 64 belong to Besta caste (fishermen). The last is the largest individual caste group involved in the retail vegetable selling. These Bestas come to the city from the surrounding region. Apart from the Bestas a majority of retail sellers come from places outside the city but within Hyderabad district as well as from Mahbubnagar and Medak districts.

Seasonal variations in the supply of vegetables to the wholesale and retail markets change the form and area of the source region to a significant extent. Sometimes the area of the source region remains the same while the production of particular vegetables goes up which are consumed by the city. In this case the regional relationship is clearly very intensive. In some seasons however the area of the source region remaining the same the number of places increase and thus there is an increase in production in which case however the relationship is extensive. Generally the supply is higher in the winter followed by the rainy season while in the summer the supply decreases considerably. This raises the price of all the vegetables but particularly affected are those which come from dispersed sources, like potatoes. The seasonal variation in the supply of vegetables is directly related to the seasonal variation in their production. It is well known that winter is the best season for growing vegetables while in summer the problem of irrigation becomes very acute. The area of the source region remains stable and free from fluctuations throughout the year. Thus, the intensity of regional

relationship, dependent as it is on the production and supplies, does have a seasonal variation.

Conclusion :

The two types of locations of vegetable markets are associated with two kinds of markets. Central location in the city with reference to the potential consumer areas attract the retail markets which sell all the vegetables. Eccentric location with reference to the potential consumer areas are associated with wholesale markets which sell in bulk.

The insignificant role of the railways as compared to the roads in the collection and distribution of vegetables within the vegetable supplying region surrounding Hyderabad, is noteworthy.

The intensity of the regional relationship and the area of such a region are directly proportional to the number of wholesale vegetable markets which, in their own turn, depend on their potential consumer population.

The regional relationship is maintained directly through the wholesale vegetable markets and indirectly through the retail vegetable markets. It is the former and not the latter which function as the direct medium between the region of the city and its population.

On the basis of the analysis given above we suggest the following scale of intensity of regional relationship.

Intensity of Regional Relationship :

1. Least intense :—
   Region : One wholesale market—One retail market.
2. More intense :—
   Region : Three wholesale markets—Several retail markets attached to one wholesale market.
3. Most intense :—
   Region : Three wholesale markets—All the retail markets attached to all the wholesale markets.

   Hyderabad—most intense category.

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THE HOT WEATHER SEASON IN BIHAR

Suresh Pandey.

In the State of Bihar the hot weather season starts from the month of March with rapid increase of temperature due to northward movement of the sun and subsequent decrease of pressures. A remarkable feature of this season is the afternoon or evening storms which burst after the heat of the day and are the chief source of scanty rainfall. The general growth of mangoes and litchi fruits depends upon the small amount of rainfall which occurs in this season. It also helps the farmers to prepare fields for *Bhadai* crops.

Pressure and Winds :

The heat rises considerably in March except in the submontane tracts in the north where the hot weather season commences with considerable meteorological changes. The slight low pressure which comes into being in the northeast part of the Peninsula intensifies the flow and velocity of the west wind. Changes in the direction of the prevailing winds have been slight except those in the northeast of the Ganga Plain. The northerly component increases a little veering to the south from west in the western districts of the plain. South of the Ganga the winds are westerly with a small component from north but on the Chotanagpur Plateau the winds are more westerly than northwesterly.

By April the feeble low pressure of the northeast Peninsula becomes more extensive and locates itself in north India covering Madhya Pradesh, Bihar, inner Orissa, West Bengal and Uttar Pradesh. Pressure increases outside this low pressure area on the land and is feeble on the seas. This leads to a more intensified flow of winds from west, the prevailing direction remaining practically the same in Peninsular portion and the western districts of the Ganga Plain but the marked changes are observed in the eastern districts of the Plain where winds tend often not only to replace the westerly by northerlies or southerlies but even by a growing easterly component. This is due to the iufluence of nor'westers of the Bay of Bengal.

By May the normal low pressure of northwest India firstly establishes itself contracting towards northwest from the northern Peninsula and the eastern plains with the advance of the month when calms become more frequent and the westerly winds begin to die away precluding the monsoonal surge.

The average monthly velocity of the winds during the hot weather season is definitely greater than that in the cold weather season with the intensification of pressure gradient delineated above. In the Ganga Plain the velocity ranges from 6·4 km per hour in March to 9·6 km per hour in May. The velocity is greater in the Plateau area. It ranges from 9·6 km per hour in March to 14·4 km per hour in May. This increase is due to a markedly steeper pressure gradient in the Plateau front than in the Ganga Plain throughout the season. The average monthly velocity of winds does not inpart a correct idea of force and speed of the winds blowing at the hot hours of the day. These winds known as 'loo' become typically hot and dusty by the middle of April and continue till the calm heralding the monsoonal surge establishes itself. The pressure conditions and gradients favourably explain their existence. They are the hottest winds of this season and blow universally in the State except in certain tracts protected against them. These spots are the hill basins of the plateau tracts. The crest of the Rajmahal hills forms an effective barrier against these winds. These winds march onward along the western flank of the Rajmahal hills from the plains of Monghyr and Bhagalpur and reach the height of 600 m (2000 ft.). To the east of the Rajmahal hills these winds terminate, mainly due to the humid atmosphere of West Bengal.

Temperature :

With the advance of the hot weather the temperature rises and relative humidity decreases to abnormal proportions. The average monthly means of actual temperatures are 23·9°-25°C (75°-77°F), 27·8°-30°C (82°-86°F) and 28·3°-31·1°C (83°-88°F) in March, April and May respectively in the Ganga plain, which of course, are in the northern latitudes. The figures for the same months for the plateau region are 23·9°-26·7°C (75°-80°F), 29·4°-31·1°C (85°-88°F) and 30°-32·8°C (86°-91°F), the lower figures being for the elevated parts. The sea-level means show the latitudinal control, the temperatures being 23·9°-25°C (75°-79°F), 28·3°-30.6°C (83°-87°F) and 29·4°-31·7°C (85°-89°F) in March, April and May respectively in the Ganga Plain, the lower figures being for the northerly submontane tracts. The corresponding figures for the plateau are 26·7°-27·2°C (80°-81°F), 31·7°-32·2°C (89°-90°F) and 32·2°-33·8°C (90°-92°F), the higher figures being for the southern tracts. An

idea of the intense heat of the summer months can be had from the table below :—

Stations	*Height above M.S.L.*	*March* °C	*April* °C	*May* °C
Purnea	124′	40·6	43·3	43·3
Darbhanga	161′	37·8	41·4	42·0
Patna	173′	42·0	44·2	45·6
Gaya	365′	41·4	45·0	46·7
Chaibasa	742′	42·2	45·6	47·8
Ranchi	2150′	38·3	42·0	43·6
Hazaribagh	2006′	38·9	41·7	43·6

Relative Humidity :

The relative humidity is minimum in April. The figures for the three months of the hot weather season successively are 45-55%, 40-50% and 55-70% in the Ganga Plain, the maximum figures being of the eastern districts. The corresponding figures for the plateau area are 34-40%, 29-40% and 41-50%, the minimum figures being for the central dry spots of the Plateau.

Table showing Relative Humidity.

Stations	*March* %	*April* %	*May* %
Jamshedpur	55	49	61
Chaibasa	61	56	62
Ranchi	42	39	50
Hazaribagh	39	31	48
Daltonganj	57	42	43
Purnea	63	63	75
Darbhanga	57	59	67
Motihari	57	47	66
Patna	49	47	61
Gaya	36	25	39
Dumka	47	50	65
Sabour	53	47	67

Precipitation :

The hot weather season in Bihar is not without some precipitation. The driest month of the season is March except in the central districts of Shahabad, Patna, Gaya and Hazaribagh where April is the driest month. This may be due to the northern districts partaking the western disturbances, which, though have moved northward, are likely to influence the weather in the northern latitudes. The southern and eastern districts get some precipitation in April owing to the proximity of the Bay of Bengal and its nor'westers. The forms of disturbances occurring in the State during this season may be classified as : (i) Dust-

storms (*Andhi*), (ii) Thunder-storms and (iii) Dust raising whirl winds.

The dust-storms or thunder-storms which generally burst in the afternoon or evening after the heat of the day are caused by convective interaction of the dry west wind blowing at high level and the damp air currents from the Bay of Bengal, the seat of anticyclone, which creep in at the lower level where the former falls away towards east. The dust-storms and thunder-storms differ only in the fact that the former is generally characterised by less precipitation and large quantity of dust while the latter by heavy rain and less dust. These storms generally come from the northwest direction and sometimes from the west.

The storms are most frequent in the State in May with a second maximum in April and June. The maximum diurnal frequency is between 15 and 20 hours of the day. The most frequent gust velocity reached is 48·2-64·3 km per hour but a gale force of 96·5 km per hour is most rarely found. Before and during the dust-storms the most frequent winds are northwesterly with a second maximum of northerly or westerly winds while during and after the storms the most frequent direction of the winds is from southwest to northeast. Rapid changes of temperature take place on the approach of the storms, the most frequent change amounting to 6^0 to 8^0F both on dry and wet thermometers but higher changes, often 20^0 to 30^0F, may occur in some dust-storms. The relative humidity generally increases with the most frequent changes being from 0 to 10%. The cumulus and cumulo-nimbus clouds are generally associated with dust-storms. These dust-storms carry less precipitation but later on change into thunder-storms and give copious rain. These storms, even without any precipitation and in spite of the blinding dust, are welcome after the hottest hours of the day in the afternoon on account of the lowering of the temperature. In the hot weather season the average number of dust-storms is about 20, 80% of which occur in May and early June, before the start of the monsoons. Thunder-storms, too, are most frequent in May with a second maximum in April and June. The number of thunder-storms is, however, lower. Out of a total amount of 14, 7 occur in the months of March and May. Thunder-storms occur generally between 17 and 20 hours of the day. The wind velocity and other meteorological conditions are similar to that of dust-storms. Pressure generally rises by about 0·7″. The nor'-

westers of Bengal, which affect the weather of the eastern and southeastern districts, are thunder-storms of special type.

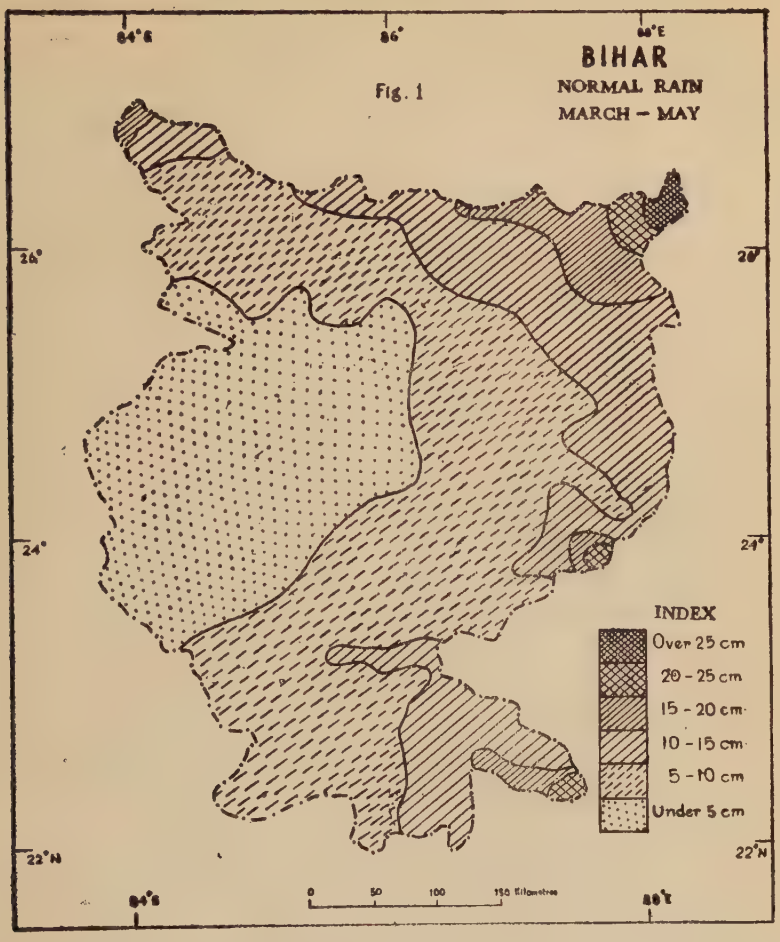


Fig. 1

In March the southeastern districts receive 25·4 to 50·8 mm rainfall. The districts of Shahabad, Saran, Champaran except the portion in the foothills of the Himalayas, Muzaffarpur, Patna, Gaya and the northwest portion of Palamau receive less than 12·7 mm. The number of rainy day is 1 for the districts of Saran, Champaran and southwestern part of Muzaffarpur. The districts of Shahabad, Patna, Monghyr and Bhagalpur in the Ganga plain have 1 to 2 rainy days. The average rainfall for these districts is less than 25·4 mm but more than 12·7 mm in March. The number of rainy days for the southeastern parts of the State is 2 to 5.

In April the number of rainy days for the districts of Shahabad, Saran, western Gaya and Palamau is less than 1. The number

of rainy days for the same month ranges from 2 to 5 in Champaran, Muzaffarpur, Darbhanga, Saharsa, Bhagalpur, Monghyr, Hazaribagh, west Purnea and Gaya districts. In the eastern part of Purnea, Dhanbad and Singhbhum the number of rainy days is between 2 to 5. The rainfall in the districts of Purnea, east Santhal Parganas, Dhanbad and Singhbhum is 25·4 mm to 50·8 mm.

In May Purnea, northern part of Saharsa and Darbhanga receive rainfall more than 50·8 mm, whereas, Saran, western part of Patna, Gaya, west Hazaribagh and Ranchi receive less than 50·8 mm. Shahabad and Palamau districts experience less than 25·4 mm rainfall.

The total for the months of March, April and May (Fig.) is consequently maximum for the district of Purnea with a normal of 20 cm. The northern and northeastern parts of Darbhanga district, whole of Saharsa and Santhal Parganas, eastern portion of Singhbhum receive 10 to 15 cm rainfall. In Singhbhum the normal is 13·9 cm owing to its proximity to the Bay of Bengal, the source of nor'westers. The districts of Champaran, Muzaffarpur, Monghyr, Ranchi, Hazaribagh, western part of Singhbhum and Dhanbad receive between 5 to 10 cm rainfall. The western districts are the driest. Saran, Patna, Shahabad, Gaya and Palamau receive only under 5 cm. The following table indicates the little rainfall which pours in the State during this season. The figures are in mm.

Stations	*March*	*April*	*May*
Patna	9·4	8·4	30·0
Gaya	11·4	6·3	22·6
Arrah	9·1	7·4	23·1
Chapra	8·9	9·9	28·2
Motihari	13·7	23·4	60·5
Muzaffarpur	8·4	13·7	51·3
Darbhanga	12·5	20·1	59·9
Monghyr	9·4	15·5	45·7
Sabour	9·7	25·1	55·4
Purnea	18·2	34·0	100·6
Hazaribagh	24·9	15·7	48·5
Dumka	21·1	26·9	85·9
Ranchi	29·0	21·0	54·6
Daltonganj	20·1	10·2	15·2
Chaibasa	21·3	26·7	67·3
Dhanbad	21·3	17·3	49·8

PEDOGENESIS IN RAJMAHAL—III

(Study of a soil catena in the Median valley)

S. P. Chatterjee, R. Lahiri, R. Bhattacharyya.

To the south of Sahibganj, beyond the Rajmahal Hills, is the median or Morang valley[1], an undulating tract of land with clusters of villages scattered all over the area. The upper valley region shows signs of ruthless deforestation, which has resulted in widespread soil erosion in the area ; innumerable gullies and ravines bear testimony to this effect. The vegetation in the hills is of a scrub-jungle type ; the valley floor has very little natural vegetation left, because all available areas have been utilised for the cultivation of paddy which is the only crop grown in the locality. The land as a whole slopes towards the river Gumani and slowly flattens and widens out further to the south. The whole area has a red soil locally known as *'ankhori'* or *lalmati*, with abundence of ferruginous gravels, which are used for surfacing the roads. In the local nomenclature no differentiation has been made between such soils with ferruginous gravels and other red soils which do not contain ferruginous gravels. In places at certain levels, there are occurrences of indurated crusts of ferruginous material. Below the crusts, at a lower level the soil has a yellowish colouration. Further down, nearer to the water lavel (table) soils of darker colour occur. This sequence may also be explained on the basis of the catena[2] concept of soil formation.

In the present paper three profiles have been studied with reference to their various topographical situation. Profile no. 4 is from the layer lying on the top of the laterite crust and profiles 5 & 6 are from below the laterite crust. Though profiles 5 & 6 are from areas a few kilometres apart, they show uniformity of properties

DESCRIPTION OF SOIL PROFILES :

Profile No.	4,
Locality	Banjhi,
Macro relief	Valley,
Site and Slope (Topographic situation)	Relict surface, slopes from west to east, Valley side,
Aspect	East,
Parent material	Siallite from the original laterite,
Vegetation	Kans grass,
Profile drainage	Good.

0-61 cm.	Reddish yellow, loose, friable soil, few fine roots and few stones ; after 46 cm the soil becomes compact and dry, changes to
61-121·9 cm	Reddish yellow soil, prismatic structure, hard, no roots, few stones, dry, changes to
121·9-182·9 cm	Yellowish red soil, vesicular, soft, no roots, few stones, moist.

Profile No.	5,
Locality	Banjhi,
Macro relief	Valley,
Site and Slope (Topographic situation)	Brick field, slopes from west to east, Valley floor,
Aspect	East,
Parent material	Siallite from the original laterite,
Vegetation	Grass,
Profile drainage	Good.
0-7·6cm	Reddish yellow soil, compact, hard, few fine roots, and no stones, black concretions, dry, changes to
7·6-15·2 cm.	Strong brown soil, compact, easy to handle, few fine roots, no stones, black concretions, wet, changes to
15·2-30·5 cm.	Strong brown soil, compact, easy to handle, no roots, no stones, moist, changes to
30·5-61 cm.	Brown soil, compact, easy to handle, no roots and stones, black concretions, moist, changes to
61-91·4 cm.	Brown to dark brown soil, compact, easy to handle, no roots and stones, black concretions, moist, changes to
91·4-121·9 cm.	Dark yellowish brown soil, massive, easy to handle, no roots and stones, black concretions, moist, changes to
below 121·9 cm.	Brown to dark brown soil, massive compact, no roots and stones, black concretions, moist.

Profile No.	6,
Locality	Borio,
Macro relief	Valley,
Site and Slope (Topographic situation)	Low lying field, plain surface, Valley floor,
Aspect	West,
Vegetation	Paddy stubbles,
Profile drainage	Slight impedence.

0-7·6cm	Yellowish brown soil, compact, hard, few fine roots, no stones, black concretions, dry, changes to
7·6-15·2cm	Dark yellowish brown soil, compact, medium handling consistency, few roots, no stones, black concretions, slightly moist, changes to
15·2-30·5cm	Brown to dark brown soil, compact, mellow, no roots and stones, black concretions, reddish tinge in the layer, moist, changes to
30·5-38·1cm	Dark brown soil, compact, mellow, no roots and stones, black concretions, moist, changes to
38·1-50·8cm	Dark brown soil, compact, mellow, no roots and stones, black concretions, moist, changes to
50 8-73·7cm	Dark grey brown soil, compact, soft, no roots and stones, black concretions, moist, changes to
73·7-111·8cm	Yellowish brown soil, compact, soft, no roots and stones, black concretions, moist.

TABLE 1

Colour Profile :

Depth in cm	Profile No. 4	Profile No. 5	Profile No. 6
0		7·5 YR 6/6 (7·5 YR 5/6)	10 YR 5/6 (10YR 4/4)
7·6		7·5 YR 6/8 (7·5 YR 5/6)	10 YR 5/6 (10YR 4/4)
15·2	7·5YR 7/8 (5 YR 5/6)	7·5 YR 6/8 (7·5 YR 5/6)	10 YR 5/4 (10YR 4/3)
30·5		7·5 YR 6/6 (7·5 YR 5/4)	10 YR 5/4 (10YR 4/3)
38·1			10YR5/6 (7·5YR4/4)
50·8			
61·0		10 YR 5/4 (10 YR 4/3)	10YR5/4 (10YR4/2)
73·7			
91·4			10YR6/6 (10YR5/4)
111·8	5 YR 6/8 (5 YR 4/6)	10 YR 5/4 (10 YR 4/4)	
121·9	5 YR 5/8 (5 YR 4/6)	7·5 YR 6/6 (7·5 YR 4/4)	
182·9			

TABLE 2

Organic Matter Profile & pH Profile :

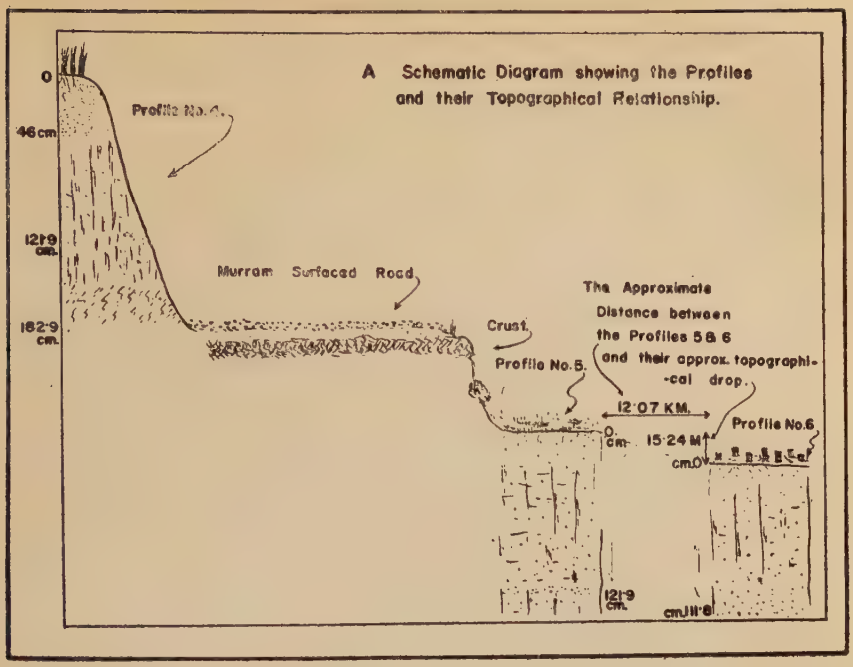
Profile No. 4			Profile No. 5			Profile No. 6		
Depth in cm	Organic matter.	pH	Depth in cm	Organic matter.	pH	Depth in cm	Organic matter.	pH
0-61	1·075%	6·5	0-7·6	3·44%	6·5	0-7·6	2·58%	6·5
61-121·9	1·22%	7·0	7·6-15·2	2·58%	6·5	7·6-15·2	2·06%	7·0
121·9-182·9	1·13%	7·0	15·2-30·5	3·09%	7·0	15·2-30·5	1·98%	7·0
			30·5-61	2·58%	7·0	30·5-38·1	1·89%	7·0
			61-91·4	2·58%	7·0	38·1-50·8	1·76%	7·0
			91·4-121·9	1·995%	7·0	50·8-73·7	1·63%	7·0
			below 121·9	1·60%	7·0	73·7-111·8	1·18%	7·0

TABLE 3

Mechanical Composition Of Soil and Texture Profile :
(Recalculated ; Sand + Silt + Clay = 100%)

Depth in cm	Sand	Silt	Clay	Total	Texture after J.A. Prescott & others.
Profile 4					
0·0-61·0	40·3	19·1	40·6	100	Light clay
61·0-121·9	39·5	19·5	41·0	100	Light clay
121·9-182·9	38·7	20·1	41·2	100	Light clay
Profile 5					
0·0-7·6	54·9	19·4	25·7	100	Clay loam
7·6-15·2	48·4	19·0	32·6	100	Clay loam
15·2-30·5	48·6	18·7	32·7	100	Clay loam
30·5-61	48·2	17·6	34·2	100	Clay loam
61-91·4	48·4	19·3	32·3	100	Clay loam
91·4-121·9	43·3	18·8	37·9	100	Light clay
below 121·9	40·2	19·3	40·5	100	Light clay
Profile 6					
0-7·6	43·0	22·8	34·2	100	Clay loam
7·6-15·2	41·1	26·2	32·7	100	Clay loam
15·2-30·5	41·3	21·8	36·7	100	Light clay
30·5-38·1	44·1	21·8	34·1	100	Clay loam
38·1-50·8	48·1	16·5	35·4	100	Clay loam
50·8-73·7	39·8	16·6	43·6	100	Medium clay
73·7-111·8	32·8	19·7	47·8	100	Medium clay

EXPERIMENTAL METHODS : The same methods as in the previous article (*Geographical Review of India*, Vol.23. No.2.), have been applied for experimental part of the work.



DISCUSSION

It has already been stated that the area, designated as the *Median* valley, is an area of red soils. The general name given to this soil is *lalmati* or *ankhori* by which, it is apparent, that only the colour of the soil has been indicated without taking the process of soil formation into account. It has been found from field observations that there are also other soils in Rajmahal, red in colour, but genetically different from the red soil of the median valley. It was quite clear from the visual observation that the median valley soil is of lateritic origin whereas the other red soils are nonlateritic in character. There are two other soil types in this area, viz, *bindi mati* and *dhob ujjalla*. Are these soils genetically related ? The answer to this question lies in the proper understanding of the principle of laterisation which has been one of the most controversial problems in contemporary pedological investigations. The principal points at issue are :

1) the mode of rock weathering resulting in the huge accumulation of the highly sesquioxidic material of a well defined honeycombed structure and having SiO_2/Al_2O_3 less than 1.33.

2) whether this material is the same as the red soil, commonly called the lateritic soil of which the SiO_2/Al_2O_3 is, somewhat higher, 1.35-2.00.

Without going into the details of the mode of rock weathering, leading to the formation of laterite, for which there is no dearth of literature, the following observations quoted from Marbut[3] will serve the purpose here :

> Lateritization and sialitization are identical. The process is essentially a desilicification process leaving behind aluminum and iron, but the silica is removed gradually, the final stage being reached only after a long time and apparently only in hot climates. In the proportion that the clay minerals contain a percentage of silica such that its molecular ratio to alumina is less than 2 to 1, in that proportion the material may be described as laterite. Laterite is a clay rock (not always consolidated) in which the silica has all been removed and aluminum hydroxide and iron hydroxide, in case the parent rock contained iron bearing materials, are left.

From investigations in the laboratory, Harrassowitz rightly concluded that desilicification is possible under the influence of hydroxyl ion (basic) but is not possible in acid medium. From this, it appears that laterite should be the final weathering product of *basic rocks* (from basic lava) whereas acid rocks like granite, gneiss, etc. would take an entirely different direction during weathering leading to what is known as podsolization.
Following Marbut further :

> The process of sialitization is a process of rock decomposition and therefore a process of soil material accumulation, The continuation of this process however beyond the siallite stage is a soil making process, and at least under certain circumstances, produces a *soil profile*. It acts on siallite after it has been accumulated and produces laterite which extends to the surface and has a series of characteristic superposed layers. Such a profile as described by Fox is as follows :

Red or Yellow clay	3 metres
Iron crust	0.3 to 2,5 metres in thickness
Mottled Zone	2.5 to 7.5 metres in thickness
Siallite Zone	4.4 to 1.5 metres in thickness
Fresh rock (Basalt)	

The thickness of the iron crust will depend on *ageing* of the process of siallitization.

In regard to the application of the term laterite to the most commonly occuring tropical red soils, it may be mentioned that the term *latosol* has been used by the American pedologists to differentiate the soil from the rock (laterite). Though the term latosol appears to be better than the term lateritic soil, yet for reasons, quite justifiable, the latter is as unsuitable as the other.

The cycle of laterisation and siallitization may be repeated if, for some reason or other, the processes of soil formation start anew. Mohr[4] in his study of the Tropical soils observes :

> Mention must be made of the fact that the type of soil development leading to the differentiation of a cemented silicified ash layer having a mottled clay zone, an accumulated B horizon and eluvial A horizon on top may occur several times within a parent material of suffieient thickness. . . .If this occurs, the unweathered material will undergo the same process of leaching, translocation and precipitation of soluble components as took place at higher level in the earlier katamorphic period, thereby creating a second complete profile.

From pedological point of view, such a soil profile is a composite of a number of profiles of weathering cycles of different ages. Such a profile has been given the name of a *polygenetic profile*.

Stephens[5], in his classification of soils has mentioned the names of two such polymorphic profiles (belonging to GREAT SOIL GROUPS) coming under Non-Pedocals, with a differentiated solum, acid to neutral in reaction and lacking pronounced eluviation of clay. These profiles are : (a) Lateritic krasnozem and (b) Lateritic red earth. The occurrence of a *crust* in the profile differentiates these two soils from Krasnozems (ferrimorphic), often widely referred to as *red loams* and are 'essentially red to brown deep friable clay soils showing very little horizon development beyond the accumulation of organic matter in the A horizon'.

'Lateritic red earths are red to light red soils with a deep profile containing a horizon of laterite with a mottled and pallid kaolinitic horizons beneath'. Lateritic red earths are largely associated with old land surfaces which have undergone weathering and erosion for quite a long period of time'.

Referring to Stephens' work, Pendleton[6] mentions that recognizably different soil types can develop on each horizon, accor-

ding to its nature of exposure, of laterites or lateritic red earth profiles. When all such soil types are correlated, it may be shown that they form one catena, the so called *secondary catena* which signifies a catenary formation, strictly speaking, not residuals on the same parent material.

From what has been discussed above, it appears that the soils of the Banjhi-Borio area in the median valley of Rajmahal are really the exposures of the different horizon of the Great Soil Group "LATERITIC RED EARTH". Originally, the basalts of the Rajmahal Hills, which represent the uplifted peneplaned surfaces of the Jurassic Age, was laterised under the tropical conditions of weathering and in all probability a profile like that described by Fox was formed. Due to erosion, the original laterite profile was truncated exposing the thick siallite horizon which under the changed conditions of environment, became the parent material for the second soil formation cycle trending towards the development of a lateritic red earth. The reddish yellow colouration (7.5YR 7/8), very low organic matter, neutral reaction (pH 6.5-7.0) and a light clay texture with a kaolin clay, all indicate the typical characteristics of the siallite horizon of a laterite profile. This siallite horizon after further siallitization has given rise to the present crust, not very strongly indurated, underlain by soil types represented by profiles 5 and 6. The top soil in profile 5 shows some variation in regard to the texture, which seems to be due to the accumulation of sand both by deposition from outside, and leaching of the finer material from the exposed surface. The bottom soil (below 91cm.) is the same light clay as in profile 4. The reddish yellow colouration (7.5YR 6/6-6/8), changing to yellowish brown (10YR 5/4) at the bottom, showing signs of mottling is the 'mottled or pallid zone' of the present cycle. Soil profile 6 which was taken from a low paddy field at Borio, has features—similar to that of the mottled zone in all respects excepting in colour and in the texture of the soil. These variations may be ascribed to the human interference which this soil is undergoing at present.

It is, therefore, believed that the *lalmati* or the *ankhori mati* represents the exposures of the A or the top horizon of a lateritic red earth, whereas the *bindi mati* represents the exposure of the mottled or pallid zone of the same soil viz. the lateritic red earth. In many places, the red soil of the lowlying area

is purely depositional, being the sediments of the wash water coming from the high level exposures of the A horizon. The third soil type of the area, locally known as *dhob ujjalla* is a rusty-white clay, collected from pockets of deposit by the local potters for making earthen ware and potteries. The genetic relationship of this soil with the lateritic red earth of the area was not investigated. Though the assumption is that this pottery clay which is an impure form of kaolin has been deposited from a flow of water in which the fine clay particles were being carried in suspension, before being deposited due to reduction of velocity of flow. This clay may therefore be called secondary or sedimentary clay. But instead of being a secondary clay, if it can be shown that this is of residual origin, then its genetic relation with the lateritic red earth formation of the area could be suggested with less difficulty.

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Book Review

NEPAL, *The Kingdom in the Himalayas*—by Toni Hagen. Published by Kummerly & Frey, Berne (Oxford Book & Stationery Co., Calcutta & Delhi), 1961. Translated by Britta M. Charleston. 24 × 30 cm. Text 118 pp. Plates 71. Maps. Price Rs. 65/-

Dr. Toni Hagen, the noted Swiss geologist working in Nepal for many years, has given in this book a general account of the land and people of this Himalayan country in a popular manner, with the help of 71 magnificent photographs, 18 sketch maps, one big map of Nepal (1: 1,408,000) and a lucid description. The author first came to Nepal 1951 as a member of the Swiss Technical Mission but was later commissioned by the U.N. Technical Assistance Administration to carry out a geological survey and prepare the first geological map of the country, which is now under way. He is now the head of the newly founded National Geological Institute of Nepal. Dr. Hagen is perhaps is the only foreigner who could travel round the country freely, visiting every valley of this mountainous land, covering as much as 14,000 km on foot. In course of his journeys he could capture by skilful and artistic use of his camera the essential aspects of the landscape and inhabitants of Nepal in an unrivalled series of photographs, 29 of them in natural colours and 42 in monochrome, incorporated in this volume. One enormous colour photograph, measuring some 90 × 16·5 cm, depicting the panorama of the entire Annapurna massif, is a masterpiece of its kind I have ever seen. This work on Nepal is not merely a collection of nice pictures, but the basic problems of this hill-girt and under-developed country are also discussed in it. This highly elegant book produced by Messrs Kummerly & Frey, the famous Swiss cartographic house, is an example of high standard of printing and publication in Switzerland.

S. Das Gupta.

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